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15. R. Bose, Calcutta, should read: S. R. Bose, Calcutta.

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STUDIES ON SPONGIPELLIS BOREALIS (FR.) PAT. [1]

by

OSWALDO FIDALGO [2]

(16.IV. 1958)

As indicated by the specific name, *S. borealis* (FR.) PAT. is a species of the northern hemisphere. It is commonly found in North America, Europe and Asia. It is a variable species which presents in the young stage circular pores and later angular or daedaloid pores.

Before 1821, it was named *Boletus albus* by JACOB SCHAEFFER, *Daedalea gibbosa* by WAHLENBERG (not *D. gibbosa* PERS.) and (?) *Boletus pithyus* by CHAILLET. But the starting point of its nomenclature is FRIES' Systema Mycologicum where it appears as *Polyporus borealis* FR. Since this time it has been placed in many other genera: *Boletus*, *Postia*, *Bjerkandera*, *Daedalea*, *Leptoporus*, *Heteroporus*, *Abortiporus*, *Tyromyces* and *Climacocystis*.

The genus *Heteroporus* LÁZARO em. DONK (≡ *Abortiporus* MURR.) is typified by *B. biennis* BULL. which has a monomitic system of hyphae, duplex context, conidiophores in the upper and softer layer which is not fibrous. The species studied by us have the two first characters, but are fibrous in the soft stratum that does not produce conidia. The genus that is characterized by all these features is *Spongipellis* PAT. as established by PATOUILLARD (1887) and BOURDOT & GALZIN (1928).

Boletus albus SCHAEFF. (1821), *Daedalea gibbosa* WAHL., and *Boletus pithyus* CHAILL. are given by FRIES (1828) as synonyms of *S. borealis*. LLOYD (1915) considered *Polyporus mollicomus* BRITZ. to be the same species. ROMELL (1926) mentioned *Polyporus mollis* PERS. and *P. mollis* ALB. & SCHW., while PILÁT (1938) includes *Polyporus piceus* VELENOV. among its synonyms. OVERHOLTS later (1953) included also *Polyporus pacificus* KAUFF. and more recently LOWE (1956) added *Bjerkandera fennica* KARST. lectotype of *Bjerkandera irpicoides* KARST. as synonyms of *S. borealis*.

In the general herbarium of the National Fungus Collections we found only one specimen as *P. mollis* PERS. This is not *S. borealis*. The specimens of *P. mollis* (no author indicated) in LLOYD's collection from ROMELL's herbarium are all *P. fragilis* FR. RICK in

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[1] A study made with the aid of a grant from the National Council of Research of Brazil in the National Fungus Collections, Plant Industry Station, Beltsville, Maryland, U.S.A.

[2] "Naturalista" of the "Jardim Botânico do Rio de Janeiro" and "Instrutor" of the "Faculdade Nacional De Filosofia Da Universidade Do Brasil", Rio de Janeiro, Distrito Federal, Brasil.

Broteria (1935) named a specimen as *P. mollis* PERS. that is also not *S. borealis.*

Polyporus cerifluus BERK. & CURT. has also been condisered a synonym of *S. borealis* (FR.) PAT. An examination of the type in the BPI 3) collections showed this to be *P. fragilis* FR. We found also notes of BRESADOLA, LOWE and GILBERTSON with the same idea. KILLERMAN thought that *P. mollicomus* BRITZ. belongs also to *P. fragilis* FR. (not *P. fragilis* KLOTZSCH). In all probability it is not *S. borealis.*

Polyporus fragilis FR. and *S. borealis* (FR.) PAT. are related species but their spores are basically different; the first species has allantoid spores, 4 — 5.5 × 1 — 2 μ while the other has ellipsoid to sub-globose spores, 5.5 — 8 × 3 — 5 μ.

An examination of the type of *Polyporus hiascens* LLOYD did not indicate any relationship with *S. borealis,* as suggested by RICK (1935).

KOTLABA & POUZAR (1958) described a new genus based on *Spongipellis borealis* named *Climacocystis.*

Spongipellis borealis. (FR.) PAT., Essai Tax. Hym. 84. 1900; Murr., Bull. Torr. Bot. Club, **32**: 475. 1905; North Am. Fl. **9** (1): 38. 1907; Bourd. & Galz., Hymen. Fr., Bul. Soc. Myc. Fr. **41**: 118. 1925; Pilát, Mykologia **3** (5, 6): 78—79. 1926; Bourd. & Galz., Hymen. Fr. 535. 1928; Pilát, Bul. Soc. Myc. Fr. **48**: 5, 1932; Konrad&Maubl., Ic. Sel. Fung. pl. 425. 1935; Teston, Bul. Soc. Nat. d'Oyonnax **7**: 82—83. 1953.

SYNONYMY

Polyporus borealis Fr., Syst. Myc. **1**: 366. 1821; Pers., Mycol. Europ. **2**: 67. 1822; Fr., Elench. Fung. **1**: 85. 1828; Secr., Mycogr. Suisse **3**: 113. 1833; Weinm., Hym. Gastr. Imp. Ross. 314—315. 1836; Rostk., in Sturm, Deutsch. Fl. **3**(4): 83, t. 40. 1838; Fr., Epicr. 459. 1838; S. Veg. Scand. 320. 1846; Karst., Finl. Polyp. 36. 1859; Quél., Champ. Jura & Vosg. **1**: 277. 1872; Berk., Grevillea **1**: 49. 1872; Fr., Hym. Eur. 552—553. 1874; Cke., Grevillea **4**: 38. 1875. Karst. Myc. Fenn., Finl. Nat. Folk, **3**: 261. 1876; Kalchb., Ic. Sel. Hym. Hung. 4, pl. 35, f. 2, 1877; Gill., Champ. Fr., Hymen., 672. 1878; Hartig, Zersetz. des Holz. 54—58, taf. 10. 1878. Stevenson, Mycol. Scot. 136 (n. 728). 1879; Wint., in Rab., Krypt. fl. **1**: 428—429. 1884; Stevenson, Brit. Fung., Hymen. **2**: 202. 1886; Allesch., Verzeichn. Sudb. Pilze, **1**: 71. 1886; II, Nachtr. 27. 1889; Sacc., Syll. Fung. **6**: 134. 1888; Bref. Unt. Ges. Myk. **8**: 111, 117. 1889; Schroet., in Cohn, Krypt.-Fl. v. Schlesien **3**(1): 471—472. 1889; Cke., Handb. Austr. Fung. 124. 1892; Mass., Brit. Fung. Fl. **1**: 248—249. 1892; Strasser, Verh. Bot. Ges. Wien. **3**: 363. 1900; Atk., Corn. Univ. Agr. Exp. St. Bull. **193**: 200, fig. 56—59, 63. 1901; Magn. Pilze v. Tirol, 185. 1905; Mass., Trans. New Zeal. Inst. **39**: 5. 1906; Höhn., Bot. Zeitschr. **56** (11, 12): 4 (repr.); Sher., Illustr. Ident. Fung. Central Russia 96. 1908; Atk., Mushrooms, ed. 3, 9, fig. 9. 1911; Jach., Ident. of Fungi I, ed. 2. 607. 1913; Overh., Ann. Mo. Bot. Gard. **1**: 100—101. 1914; B. O. Dodge, Trans. Wisc. Acad. Sci., Arts. & Let. **17**(2): 827. 1914; Neuman, Wisc. Geol. & Nat. Hist. Surv. Bull. **10**: 95. 1914; Lloyd, Myc. Writ. **4** (Syn. Apus): 326, fig. 668—670. 1915; l.c. (Let. 60): 13 (370). 1915; Sacc., Fl. It. Crypt. I, Fung. Hym. **15**: 987—988. 1916; Rankin, Man. Tree Dis. 185—186.

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3) BPI — international abbreviation used for The National Fungus Collections according to LANJOUW, J. & F. A. STAFLEU — Index herbariorum, part I — The herbaria of the world, p. 8. 1952.

1918; Oud., Enum. Syst. Fung. **1**: 362, 435, 588. 1919; **2**: 43, 789. 1920; **5**: 676. 1924; Lloyd. Myc. Writ. **7** (Myc. Not. 66): 1129 (1063). 1922; Velenov. České Houby 648—649. 1922; Kill., Bayern. Bot. Ges. Regensb. **15** (1): 74. 1922; Fritz. Trans. Royal Soc. Can. **17**: 228—232. 1923; Neger, Krank. uns. Waldb., ed. 2, 232. 1924; Hubert, U. S. Dept. Agr. Bull. 1262, p. 4, 12. 1924; Jour. Agric. Res. **29** (11): 557. 1924; Spilger, Pilze in Adna p. 53, t. 13, 2. 1926; Vakin, Izv. Leningr. Lesn. Inst. **35**: 114, 1927; Cunn., Trans. New Zeal. Inst. **58**: 243. 1927; Shope, Ann. Mo. Bot. Gard. **18**: 335, pl. 20. 1931; Robak, Sv. Bot. Tidsk. **26** (1—2): 267—270. 1932; Lowe, Bull. N. Y. State Coll. For. **6**: 75, Tech. Publ. 41. 1934; O. Rostr., Dansk Botanisk Arkiv **8**(8): 30. 1935; Bisby, Fung. Manit. Saskatch., 84. 1938; Jørst. & Juul, Medd. Norske Skogf. **6**(3): 346—361, fig. 12—16. 1939; L. K. Henry, Ann. Carn. Mus. **28**: 238. 1941; Lowe, Bull. N. Y. St. Coll. For. **15**(3): 70, Tech. Publ. 60. 1942; Cartwright & Findlay, Dec. Timb. Prev., 80. 1946; Nobles, Can. Jour. Res. C, **26**: 355. 1948; L. K. Henry, Proc. Penn. Acad. Sci. **22**: 89. 1948; Overh., Polyp. U. S., Alaska and Canada 312—314. 1953.

Boletus borealis (Fr.) Wahl., Fl. Suec. **2**; 956 (2.000). 1826.

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Bjerkandera borealis (Fr.) Karst., Acta Soc. Fauna Fl. Fenn. 2, **1**: 29. 1881; Ryssl. Finl. Scand. Hattsv. **2**: 40–41. 1882; Finl. Basidsv. 126. 1889.

Daedalea borealis (Fr.) Quél., Enchir. Fung. 184. 1886; Fl. Myc. 374. 1888; Bigeard & Guill., Fl. Champ. Sup. Fr. **2**: 392. 1913; Rea, Brit. Basid., 617. 1922.

Leptoporus borealis (Fr.) Pilát, Atl. Champ. Eur. **3**(1): 234, fig. 85. 1938: **3**(2): pl. 147–151, 153–154. 1938.

Heteroporus borealis (Fr.) Bond & Sing., Ann. Mycol. **39**: 62. 1941.

Abortiporus borealis (Fr.) Sing., Mycologia **36**: 68. 1944. Bond., Polyp. Europ. Part. U.S.S.R. & Caucasus, 542–544. 1953.

Tyromyces borealis (Fr.) Imaz., Govt. For. Exp. Sta. Bull. **67**: 31. 1954; Kotl. & Pouz., Cěská Mykologie **10**: 63. 1956.

Climacocystis borealis (Fr.) Kotl. & Pouz., Česká Mykologie **12**(2): 95–101. 1958.

(?) *Boletus albus* [Schaeff., Fung. Bav. Palat. Ic. **4**: 92 (n. 195) pl. 314. 1774; l.c. 124 (n. 279) pl. 314. 1800]. Type locality — Bavaria, Germany.

Daedalea gibbosa [Wahl., Fl. Upsal. 454 (n. 1044). 1820 (non *D. gibbosa* Pers., Syn. Meth. Fung. 501. 1801.)] Type locality—Upsala, Sweden.

Boletus pithyus Chaill., see Fr., Elench. Fung. **1**: 85. 1828.

Bjerkandera irpicoides Karst. Soc. F. F. Fenn. Act. **27** (4): 5. 1905; Lowe, Mycologia **48**(1): 101. 1956. Type locality — N. Togo Fagervik, Finland.

Spongipe (1) *lis ambiens* Karst., Trav. Sous-Sect. Troitzk. – Kiakhta, Sect. pays d' Amour Soc. Imp. Russe Geog. **8**(1): 61. 1906; Lowe, Mycologia **48**(1): 122. 1956.

Polyporus piceus Velenov., České Houby 645–646. 1922. Type locality — Jeban–Sázava, Czechoslovakia.

Polyporus pacificus Kauff., Pap. Mich. Acad. Sci. Arts & Let. **11**: 178–179. 1930. Type locality — Lake Quiniault, Washington. U.S.A.

Grifola pacifica (Kauff.) Kauff., l.c.

Type locality: Mountains of Småland, Sweden, (on trunks of *Abies*). Illustrations — as *Polyporus borealis* Rostk., in Sturm. pl. 40. 1838; Kalchb. pl. 35, f. 2. 1887; Hartig, taf. 10. 1878; Atk., fig. 56–59, 63. 1901; Fig. 9. 1911; Ames, pl. X, fig. 12. 1913; Neuman, pl. 11, fig. 39, 1914; Lloyd, fig. 668–670. 1915; Neger, fig. 202–203. 1924; Shope, pl. 20, fig. 1–4. 1931; Graham, pl. 9, fig. 8. 1944. Overh. fig. 132–135, 555; 572, 599, 626 and pl. 128. 1953; as *Boletus albus* Schaeff. pl. 314. 1774 & 1800; as *Spongipellis borealis*. Bourd, & Galz., fig. 150. 1927; Konrad & Maubl. pl. 425. 1935; Teston, pl. I, n. 3. 1953; as *Polyporus pacificus*, Kauff., pl. 24–26. 1930; as *Leptoporus borealis*, Pilát, **3**(1): fig. 85; **3**(2): pl. 147–151, 153–154. 1938; as *Abortiporus borealis*, Bond., t. 158. 1953; as *Tyromyces borealis*, Imaz. & Aoshi, fig. 3. 1955; as *Climacocystis borealis*, Kotl. & Pouz. p. 97–99. 1958.

Macroscopic Characteristics

Sporophores — fleshy when young but normally corky with age, soft, inodorous and watery when fresh, rigid, with a slight anise odor on drying, 3 – 15 × 4 – 20 × 0.5 – 4 cm. sessile or pleuropodial in the *spathulatus* form or substipitate and mesopodial in the *borealis* form; pilei spathulate, reniform, rarely dimidiate or imbricate, but at times in multiplex clusters on which *Polyporus pacificus* was based.

Stipe — present or not, stemlike with attenuate base, occurring in specimens developed from buried wood; Kauffman described the presence of a sclerotium at the base of the stipe of *P. pacificus*, but Overholts thinks that this was "probably the rooting stemlike base, occasioned by the growth of the plant from deeply buried wood."

Pileus surface — white when young and fresh, yellowish in age and on drying it becomesR4)–XV, f (Light Buff) to R–XV, i (Ochraceous Tawny) or MP4) – 9D2 (Cream) to MP – 12E5 (India Buff), tomentose to hispid, or rough and radially fibrillose.

Margin — entire, thick or thin, obtuse or acute, curved downward or not at all when dry, at times a little lobate and normally also a little darker than the rest of the pileus.

Pore surface — white when fresh, R-XV, b (Ochraceous-Buff) to R-XXIX (Orange Cinnamon — more reddish) or MP-9H6 (near Golden Corn) to MP-13K12 (Amber Br.) on drying; pores at first round, later angular or daedaloid (cfr. Atk. 1901, figs. 58 & 59 and Pilát 1938, pl. 147 & 148), 1–4 per mm, 1–10 per sq. mm., dissepiments coriaceous, thick or thin, entire or may be dentate or dentate-fimbriate with age.

Hymenial layer — represented by only one layer of tubes; tubes 3–15 mm. long, pale to cream.

Context — white or whitish, typically duplex, 0.3–2 cm. thick, with an upper soft and fibrous layer which is spongy and a lower stratum which is 1–5 mm. thick, hard and fibrous.

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4) R — abbreviation of colors indicated in Ridgway, R. — Color standards and nomenclature — 43 pp., 53 pl. 1912.

MP — abbreviation of colors indicated in Maerz, A. & Paul, M. R. — A dictionary of color — McGraw-Hill Book Co., N.Y. 207 pp., 56 pl. 1930.

Microscopic Characteristics

Context — at the surface of the margin are found hyaline generative hyphae, not thickened, straight, little branched, stained pink by phloxine, with simple clamp-connections, but sometimes multiple, 4–7 μ, rarely 8 μ in diam. and forming the tomentum of the margin; the same hyaline and generative hyphae with clamps 3–4μ in diam., branched and tortuous, at times with thick walls and joined in groups which give the fibrous aspect, are observed in the upper layer of the context, where they form a soft layer (Fig. 1); in the firmer part of the context are present two extreme forms of generative hyphae, both with clamps (Fig. 2): 1–hyaline, thin walled, 2.5–4.5μ

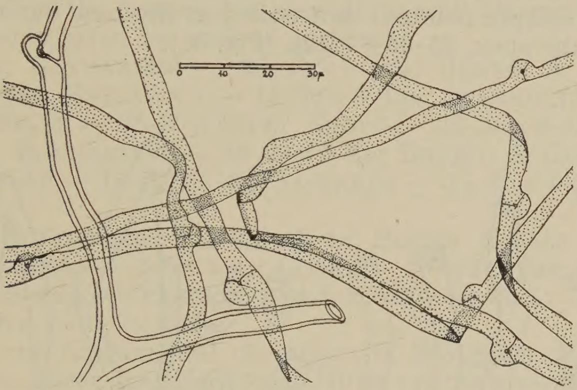

Fig. 1. Generative hyphae of the upper layer of the context with abundant clamps; the darker are thin walled and well stained by phloxine.

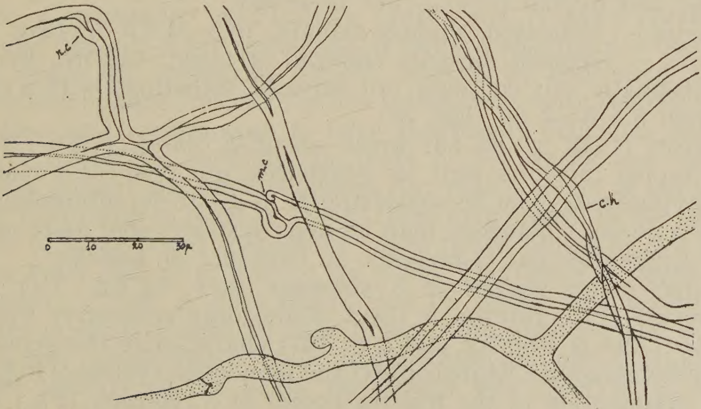

Fig. 2. Generative hyphae of the lower stratum of the context, mostly thick walled and with occasional clamps; r.c. — remnant of clamp; m.c. — aborted multiple clamp formation; c.h. — collapsed generative hypha.

in diam. and pink with phoxine; 2–hyaline, thick walled to solid, 4.5–8μ in diam., wall 2–3.5μ thick and not stained by the phloxine which stains the protoplasm.

Sub-Hymenium — hyphae narrower than above 1.5–3μ in diam., more or less thickened and for this reason the thicker ones being less stained by phloxine than the thinner.

Cystidia — normally scarce, sometimes, but rarely, found in great abundance, projecting or partially or entirely buried, in the hymenium. They are ventricose (fusiform, ellipsoid or oblong), hyaline, obtuse to sharply pointed, thin walled at the base but very thick walled at the apex, 25–35×7–12μ (Fig. 3c).

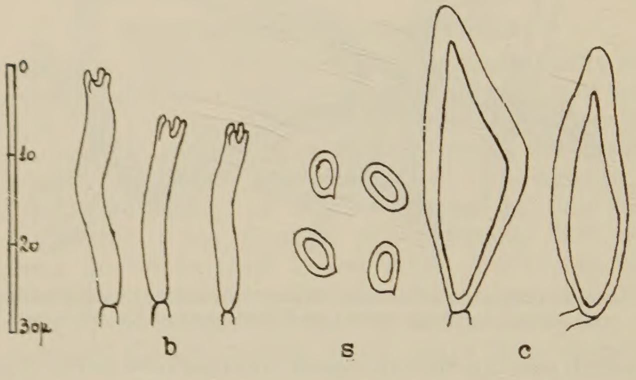

Fig. 3. b — basidia; s —spores; c — cystidia.

Setae and hyphal pegs — not observed.

Basidia — elongated, slightly clavate, 16.5–24×5–7μ (Fig. 3b).

Spores — ellipsoid, broadly ellipsoid or ovoid, smooth, hyaline with plasmatic, oily contents, not amyloid, sometimes with a small apiculum 5.5–8×3–5μ (Fig. 3s).

Teston (1953, p. 82–83) wrote about *S. borealis* (Fr.) Pat.: "Les hyphes incolores sont les génétrices, qui peuvent s'épaissir, et les hyphes roses sont les squelettiques. Il existe des intermediaires au point de une coloration, mais les deux systèmes sont assez nettement différenciés par la présence ou l'absence de boucles".

Teston in her studies on *S. spumeus* (Sow. ex Fr.) Pat. and *S. schulzeri* (Fr.) Bourd. & Galz. found only generative hyphae and Kotlaba & Pouzar (1957, p. 167) characterize the genus by the duplex structure, white context and monomitic system of hyphae.

An examination of the fruiting-bodies of *S. borealis* (Fr.) Pat. by phloxine shows only the presence of generative hyphae, but her mis-interpretation is very natural. In the beginning of our studies we were also sure "about the presence of two kinds of hyphae" in

S. borealis but later we found clamps in "both kinds" an also remnants of other clamps in hyaline hyphae.

When the generative hyphae are young they have clamp-connections, no thickened walls and stain pink in phloxine. Later the walls became more and more thickened and protoplasm and clamp-connections disappear and then the hyphae are colorless because the walls do not retain the stain and for this reason we have hyphae with intermediate colors. At times we can find clamps in this later stage but they are very rare.

Variation of the microscopic elements is well illustrated by the measurements given by various authors:

Cystidia: BONDARZEW — 25–30 × 7–12μ; BOURD. & GALZ. — 26–30 × 6–12μ; BRESADOLA — 15–30 × 8–15μ; OVERHOLTS — 24–40 × 7–10μ; PILÁT — 25–30 × 6–14μ; SHOPE — 25–35 × 8–15μ.

Basidia: BONDARZEW — 18–23 × 5–6μ; BOURD. & GALZ. 18–24 × 5–6μ; PILÁT — 18–25 × 5–6μ; SACCARDO — 15–20 × 4–5μ; SHOPE — ? × 4–7μ.

Spores: BONDARZEW — 4–6.5 × 3–4μ; BOURD. & GALZ. — 4–7 × 3–5μ; BRESADOLA — 5–6 × 3–4μ; COOKE — 4.5 × 3μ; JØRST. & JUUL — 6–8 × 3.5–4.5μ; OVERHOLTS — 4.5–7 × 3.5–5μ; PILÁT — 4–6.5 × 3–5μ; SHOPE — 6–8 × 4–5μ.

One of the fundamental characters of the genus *Heteroporus* LÁZARO em. DONK (≡ *Abortiporus* MURR.) is the presence of conidiophores and conidia in the soft stratum. These are not observed in *S. borealis* and for this reason and also because of its fibrous structure of the upper layer we exclude it from this genus.

Cultural Characters

This fungus has been well-studied in culture and especially by FRITZ (1923), ROBAK (1932), DAVIDSON, CAMPBELL & BLAISDELL (1938), CARTWRIGHT & FINDLAY (1946) and NOBLES (1948). In agar and diamalt & syrup medium, it forms a soft, more or less thin, pure white and inodorous colony, marked by concentric zones, alternately opaque and more or less transparent, with slender radiating lines and furfuraceous to felty and finally pellicular surface. Growth moderate, covering the plate in 3–5 weeks and the old cultures present the same yellowish tint that is found in old specimens. According to NOBLES (1948) there may appear in the culture foliose or large-pored sporophores over raised lumps at the edges of the Petri dish after four to six weeks. DAVIDSON, CAMPBELL & BLAISDELL (1938, p. 687) report that on tannic acid medium *S. borealis* presents a light to dark brown diffusion zone and a dark brown and opaque one in gallic acid medium and also that, caused by the toxicity of the acids, no growth was observed in either medium. The positive reaction of the culture for oxidase were tested with guaiacum solution, and germination of the spores in water and in nutrient media, are also indicated.

Hyphal Characters in Culture

Advancing zone — generative hyphae, hyaline, thin-walled, 2–5μ in diam. and with granular contents and numerous clamp connections.

Aerial mycelium — well developed in the zone 4–8 m distant from the margin that contains generative hyphae as in the advancing zone, with aerial contorted tips covered by small crystals.

Submerged mycelium — generative hyphae with the same aspect of those of the advancing zone only a little larger.

Chlamydospores — abundant, hyaline, with granular contents, ellipsoid, subglobose, globose, pear shaped or irregular, normally thick-walled, intercalary or terminal, 9.5–19.5 × 7–12.5μ (Fig. 4). Nobles (1948) gives the following variation of the chlamydospores: 12–21 × 6–16.5μ and Fritz (1923) and Cartwright & Findlay (1946) 10–20 × 6–10μ. In the aerial mycelium the chlamydospores are often terminal with thick walls, while in the submerged mycelium, they are intercalary or terminal with thinner walls.

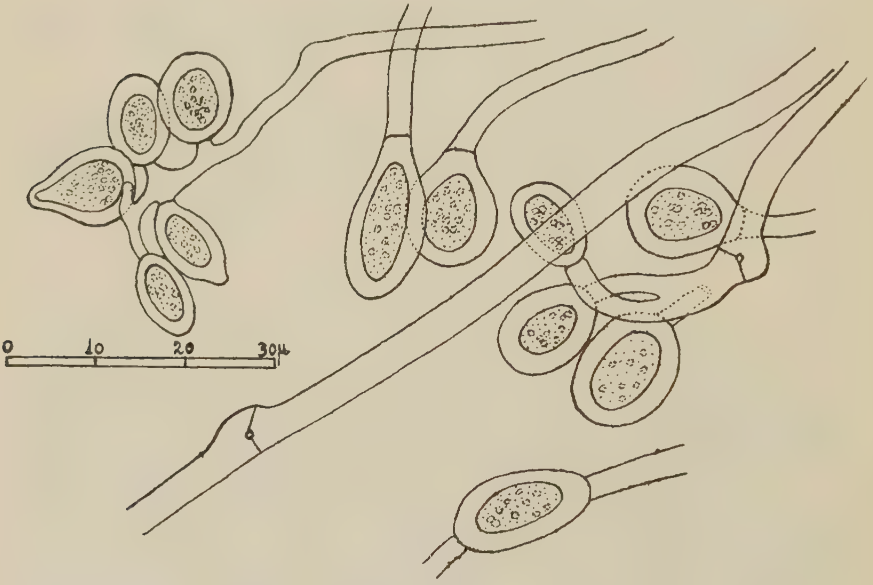

Fig. 4. Chlamydospores from culture.

Cartwright & Findlay (1946) report the presence in cultures of "secondly fibrous thick-walled hyphae with few or no clamps which develop later." We did not see these hyphae in culture, but our cultures did not produce fruiting bodies. The observation, otherwise, is quite correct because, from the description, it seems to us that they are the same kind of generative hyphae with thickened walls, observed in the sporophores and in all probability, might appear in old culture. Robak (1932, p. 267–270) in his culture

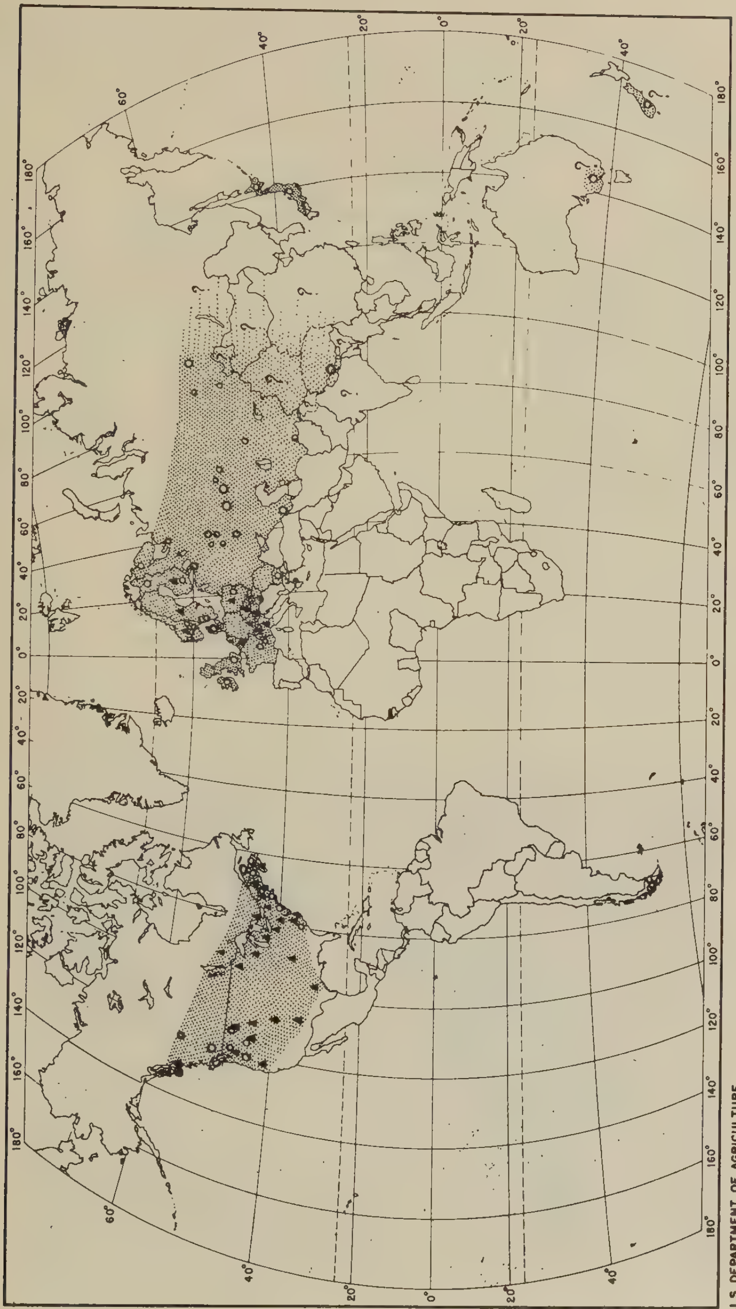
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Fig. 5. Geographical distribution of *Spongipellis borealis* (Fr.) Pat.

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studies arrived at the conclusion that *S. borealis* has tetrapolarity.

Cultures examined — 71204 – on *Tsuga* sp. – Tionesta Nat'l. Area, Pennsylvania. Overh. Campbell & Sleeth. Aug. 14, 1936; 91430 – on *Picea sitchensis* Trantv. & Mey, Long Island, Tongass Nat. For. Alaska. C. H. Englerth; Oct. 2, 1942.

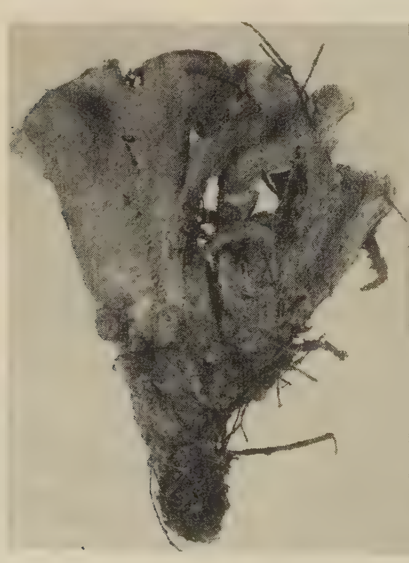
Basidiferous forms

Fries (1828, **1**: 85) described two forms for this species: *montanus* and *spathulatus* and later Murrill (1905) indicated that these should be placed in *Spongipellis*. Normally the f. *montanus* corresponds to the specimens with central stipe while the f. *spathulatus* is represented by pleuropodial specimens. The f. *spathulatus* is the most characteristic and common form of the species but Kotlaba & Pouzar (1958) changed f. *montanus* to f. *borealis* to conform to the International Rules. Sometimes we can observe intermediate types between these forms, as indicated in the geographical distribution.

S. borealis (Fr.) Pat. f. *spathulatus* (Fr.) Murr. — pilei thin, villose or fibrous, margin acute, pores angular, dissepiments dentate, lacerate or entire but always acute. (Fig. 6).

S. borealis (Fr.) Pat. f. *borealis* n. comb. (= f. *montanus* Fr.) — pilei fleshy, thick, hairy, margin obtuse, pores circular or daedaloid, dissepiments obtuse or acute and entire. (Fig. 7).

S. borealis (Fr.) Pat. f. *rohrbacheri* (Kotl. & Pouz.) n. comb. (= var. *Rohrbacheri* Kotl. & Pouz.) — sporophore clearly stipitate; stipe 1–6 cm long and 1.5 – 2.8 cm in diameter.



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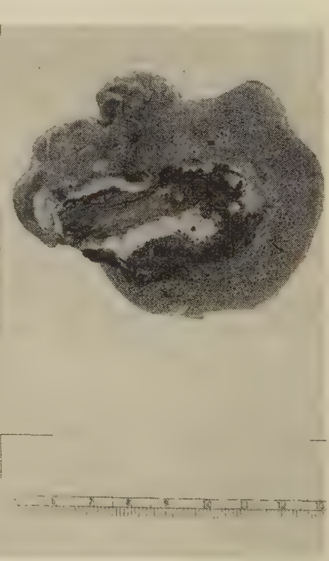

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Fig. 6. *Spongipellis borealis* (Fr.) Pat. f. *spathulatus* Fr.) Murr.
Fig. 7. *Spongipellis borealis* (Fr.) Pat. f. *borealis*.

BOUDIER (1887) described a new ptychogastric species named *Ptychogaster rubescens* which SACCARDO (1888) transferred to *Ceriomyces*. Later BREFELD placed it in *Oligoporus*. According to BOUDIER this "species" would be a form of *Poria vaporaria* (FR.) BRES., while HENNINGS suggested its relation with *Radulum spathulatum* (SCHRAD.) BRES. and LLOYD & KILLERMAN established the connection with *Spongipellis borealis*. Later DAVIDSON, CHRISTENSEN & DARLEY (1946) proposed to include *P. rubescens* "within the limits of variation of *Polyporus guttulatus* PK." a species that PILÁT (1938) put under *Leptoporus stipticus* (PERS. FR.) ex QUÉL. *Polyporus guttulatus* and *Spongipellis borealis* are definitely related species, both normally having sporophores with white context, but at times, *P. guttulatus* shows a little pink hue in the context. By the examination of cultures of *Poria vaporaria* (FR.) BRES., *Radulum spathulatum* (SCHRAD.) BRES., *Spongipellis borealis* (FR.) PAT., *Polyporus guttulatus* PK. we can see that only the one of *P. guttulatus* has the same color of the culture as *Ptychogaster rubescens*. We also compared the cultures of *P. rubescens* and BOUDIER's specimen, the type of this species, sent to us from Paris. The type presents ellipsoid, sub-globose to globose conidiospores, first homogeneous, hyaline and colorless but later with granular and pinkish contents, 5.5–7.5 × 3–5μ. In the cultures the spores had exactly the same aspect in shape and size, differing only in relation to the content that presents a paler pinkish color. The cultures of *Polyporus guttulatus* shows also the same kind of spores 5 – 8 × 3 – 5.5μ, while *S. borealis*, in culture, presents chlamydospores 9.5 – 19.5 × 7 – 12.5μ. Therefore we under stand that *Ptychogaster rubescens* is in reality a chlamydosporophoric condition of *Polyporus guttulatus* and not of *S. borealis* or any other indicated species. About *Ptychogaster albus* we cannot give any opinion whether it is a form of *S. borealis*, as suggested by FRIES as we could not obtain the type and in the herbarium, many different things were found under this name.

Habitat — found on logs and stumps, buried roots and trunk and on living trees, especially conifers, and occasionally on Angiosperms. The specimens examined are reported on *Abies* (fir), *Acer* (maple), *Fagus*, *Larix* (larch), *Picea* (spruce), *Pinus* (pine) and *Tsuga* (hemlock). The following species are reported as hosts of the specimens of *S. borealis* examined:

Gymnospermae: 1 – *Coniferae*:

Abies balsamea (L.) MILL., MARSBALL, 1914
Abies grandis LINDL., ? 1915; KIMMEY & LIGHTLE, 1950.
Abies lasiocarpa HOOK., WEIR, 1915.
Larix occidentalis NUT., ? 1920.
Picea alba LINK (as *Abies*), PILÁT, 1935.
Picea Engelmanni ENGELM., WEIR (many times).
Picea excelsa LINK., SIEMASZKO, 1922; WEESE, 1927; PILÁT, 1935; KARI, 1936; H. & P. SYD., 1903 (as *Abies*).

Picea nigra L. (as *P. rubens*), WEIR, 1904; SPAULD. & HANSBROUGH, 1941; (as *P. rubra*), DAVIDSON, 1949; HANSBROUGH, 1941.
Picea pungens ENGELM., MIELKE, 1946; SOLH., 1957.
Picea sitchensis TRANTV. & MEY., WEIR, 1913; CHILD & TRYON, 1940; ENGLERTH, 1942; KIMMEY, 1953.
Pinus Strogus L., WEIR, 1914.
Pinus sylvestris L., WEESE, 1927.
Pinus Taeda L., EDSON, 1938.
Tsuga canadensis (L.) CARR., EDSON & STEVENSON, 1936; WEIR, 1904; CHARLES, 1938; SHEAR, 1936; MURR., 1909; GRAVATT, 1920; A. AMES, 1913; SPAULD., 1910; ENO, 1935.
Tsuga heterophylla SARG., ? 1911.

Angiospermae: 1 – *Fagaceae*:

Fagus grandifolia EHRH. (≡ *F. americana* SWEET.) SEYMOUR 1929, p. 239.
Fagus sylvatica L., PILÁT, 1935.

In addition to the above *S. borealis* has been reported on the following hosts:

Gymnospermae: 1 – *Coniferea*:

Abies sibirica LEDEB., KRAWTZEW (Fung. dis. on Siber. *Abies*) 1933, p. 20.
Picea glauca (MOENCH) VOSS, ZILLER. 1957, p. 24.
Picea nigra L., ATK. 1900, p. 333–334; 1901, p. 203 (as *P. rubra*); FRITZ, 1923, p. 228 (as *P. mariana*).

Angiospermae: 1 – *Sapindaceae*:

Acer saccharum MARSH., MURR., 1920, p. 41–2; HUBERT, 1924, p. 4; 1924a, p. 557.

2 – *Salicaceae*:

Populus sp. NEUMAN, 1914, p. 95.
Populus tremula L., PILÁT, 1932, p. 5.

3 – *Fagaceae*:

Quercus sp. PILÁT, 1938, p. 235.

Exsiccatae – RAB., Fung. Europ. Ser. II, Cent. XVIII, 1703; THUM., Fung. austr. 1107 (the specimen found at BPI as *P. borealis* under THÜMEN'S number 1107, from Bohemia-Finnwald, collected on *Picea excelsa* LINK. is in reality *Phellinus igniarius* (L. ex FR.) QUÉL.); THÜM., Mycoth. 1403 (this is really *P. borealis*); KARST., F. Fenn. 238; Rom., Fung. Scand. 115; Oud., F. Neerl. 226; Mich. Coll. **7**: 16 (not *P. borealis* FR. but *P. galactinus* BERK.)

Distribution

The species has been reported from Europe, Asia and America, and is for the most part limited to the boreal hemisphere (fig. 5), fruiting mainly in August, September and October. The only notices that we have so far found about its presence in the austral hemisphere are given by STEVENSON (1879), MASSEE (1906), COOKE (1892) and Cunningham (1927) who report it from New Zealand and Australia.

The specimens examined were from the following places (▲):

1 — f. *spathulatus* (Fr.) Murr.:

U.S.A. (La.?) — Langlois (BPI); Randolph, Sept. 1897 (BPI); *Alaska* — Ketchikan — Weir, Sept. 1913 (BPI); Long Island, Tongass Nat. For. Englerth, Oct. 2, 1942 (BPI); Vank Island — Kimmey, July 22, 1953. *California*, N.E. of Orick — Kimmey & Lightle, Sept. 28, 1950 (BPI); *Colorado*, Cascade — Harper, July, 1908 (Lloyd Coll. 35265 — BPI); *Idaho*, Priest River — Weir, Aug. 1915 (Lloyd Coll. 35267 — BPI); Coolin — Weir, Sept. 1913 (BPI); Marble Mt., St. Joe Forest — Weir (BPI); Maine, Greenville — Davidson, Sept. 21, 1949 (BPI); logging camp near Greenville — Davidson. Sept. 23, 1949 (BPI); *Massachusetts*, Roxbury — Weiss. (Lloyd Coll. 41043 & 41049, BPI); Harvard Forest, Campbell & Hansbrough, Oct. 14, 1937 (BPI); Waltham — Morris (Lloyd Coll. 35252 — BPI); *Michigan*, Naebish — Harper, Aug. 1897 (BPI); *Montana*, Evaro. Sept. 1915 (BPI); Troy., Oct. 21, 1911 (BPI); *New Mexico*, Santa Fé Nat. For. — Mielke, Sept. 26, 1946; *New York* — Ballou, (Lloyd Coll. 41026 — BPI); Pack Forest, Warrensburg — Lowe, Oct. 1, 1949 (BPI), Cranberry Lake — Pennington, Aug. 20—25, 1916 (Lloyd Coll. 41029 — BPI). *Oregon*, Neshavin — Childs & Tryon, Sept. 25, 1940 (BPI); *Pennsylvania*, Philadelphia — W. C. Stevenson (Lloyd Coll. 41025 — BPI); Tionesta Nat.Area — Overh. et al., Aug. 14, 1936 (BPI); Armstrong Co., near Leachburg — Sumstine, Oct. 8, 1938 (BPI); Westline — Campbell & Davidson, June 17, 1940 (BPI); *Tennessee*, Indian Gap, Great Smoky Mts. — Hesler, June 26, 1946 (BPI); Townsend — Weir, Aug. 1904 (BPI); Rugby — Perc. (Lloyd Coll. 40613 — BPI); *Vermont*, Ripton — Burt, Nov. 4, 1896 (Lloyd Coll. 41024 — BPI); Chelsea — Hadley (Lloyd Coll. 35272 — BPI); Poultney — Eno, Sept. 27, 1935; Peru — Hansbrough, Sept. 30, 1941; *Virginia*, Natural Bridge — Gravatt, Aug. 26, 1920 (BPI); Shenandoah Nat. Park, White Oak Canyon — Edson & Stevenson, Sept. 24, 1936 (BPI); near Blacksburg — Shear, Oct. 11, 1936 (BPI); Mountain Lake — Murr., July 8, 1909 (BPI); *Washington*, Montesano — Grant, May, 1922 (BPI); *Wisconsin*, Madison — Neuman (BPI).

Canada — *Ontario*, Gull Lake Portage, Lake Temagami — Groves, Sept. 9, 1935 (BPI); *Nova Scotia* — Mac Clements (Lloyd Coll. 35264 — BPI).

Austria — North Tirol, St. Maria Waldrast, Matrei-Weese, Sept. 1927 (BPI) Sachsen, Schandau — H. & P. Syd., Aug. 25, 1903 (BPI).

Belgium — Gand — Bambeke (Lloyd Coll. 35266 — BPI).

Czechoslovakia — Bohemia, Trebon-Weidm. (Lloyd Coll. 41042 — BPI); Carpathos, Trebusãny, Bilý Potok — Pilát, Aug. 1935. (BPI).

Finland — Nylandia, Helsingfors — Malmstrom, Oct. 9, 1938 (OKF); Kärsämaki, Munttismäki — Kari, Sept. 14, 1936 (BPI).

Germany — Bavaria, Stärnberg, Sept. 1910 (BPI).

Hungary — Sopron, Brennbergbánya — Brener, 1943 (OKF).

Italy — Bres. (BPI).

Norway — Öpland, Billudden — N. Fries & Nannf. July 10, 1945 (BPI).

Poland — Puszcza Bialowieska — Siem, Aug. 1922 (BPI).

Sweden — (Lloyd Coll. 40614 — BPI); Stockholm — Rom. (BPI); Uppsala (Lloyd Coll. 35270 & 35268 — BPI); Drottningholm — 1905 (Lloyd Coll. 35269 — BPI); Blekinge, Tolsebolda — Wickland, Oct. 24, 1946 (OKF).

Switzerland, Neuchatel — Thüm. 1878 (BPI).

2 — f. *borealis*:

U.S.A. — *Michigan*, Ann Arbor — Povah, Sept. 1917 (Lloyd Coll. 41041 — BPI) *Minnesota*, Ceass Lake — Marshall, Sept. 1914 (BPI); *New York*, Ithaca — A. Ames, Sept. 1913 (BPI); Syracuse — Pennington (BPI). *Ohio*, Akron — G. D. Sm. (Lloyd Coll. 35273 — BPI); *Tennessee*, near Townsend — Weir, Aug. 1904 (BPI); *Texas*, Jacksonville — Edson, Mar. 21, 1938 (BPI); *Vermont*, Newfane — Hibbard, Sept. 10, 1917 (Lloyd Coll. 35261 — BPI); *Virginia*, Shenandoah Nat. Pk. Limber lost — Charles, Sept. 27, 1938 (BPI); *Wisconsin* — Hubert. Sept. 1921 (BPI); Mofit — Herbet. Sept. 11, 1921 (BPI).

Canada — Ontario, Toronto, Don Valley — Faull, Oct. 5, 1917 (BPI).

Austria — Tirol — Keissl., Sept. 1923 (BPI); Wien, Schneckberg — Höhn., 1905 (Lloyd Coll. 35271. BPI).

Czechoslovakia — Bohemia — Weir (BPI).

Switzerland — Neuchatel, Oct. 1872 (BPI).

3 — Intermediate especimens:

U.S.A. — *Connecticut* — East Granby — Spauld., Sept. 18, 1910. *Idaho* — Bonner Co., Priest River, Kanikau Nat. For. Aug. 2, 1920 (BPI); *Maine* — Bar Harbor — Morse, Nov., 1935 (BPI); *Wyoming* — Pilgrim Creek, Grand Teton National Park, alt. 2200 m., Solh., Aug. 18, 1957.

In the literature we find many other indications about the occurrence of *S. borealis*. (O) Overholts (1953, p. 312—314) indicates its presence in the *U.S.A.* from Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York, Pennsylvania, New Jersey, Virginia, North Carolina, Tennessee, Ohio, Michigan, Colorado, Montana, Idaho, Oregon and Washington (State), and in *Canada* from Nova Scotia, New Brunswick, Prince Edward Island and British Columbia and also in *Alaska*. L. K. Henry (1941, p. 238; 1948, p. 89) mentions *S. borealis* in many counties of the State of Pennsylvania: Allegheny, Armstrong, Bedford, Blair, Clarion, Centre, Lawrence, McKean, Somerset, and Westmoreland.

Pilát (1938, p. 325—236) gives an extensive list of localities: *Austria*: Oberösterreich (Heufler, Cartwright), Tirol (Litschauer), Katzelsdorf (Huber), Frohsdorf (Huber), Steiermark (Lohwag), Stubaier Alpen (Litschauer), Ennstal Kulm (Lohwag), Sonntagsberg (Strasser); *Bulgaria*: Rila Pl. (Bubák); *Czechoslovakia*: Štěchovice (Veselý), Klet (Pilát), Volary (Herink), Říčany (Sak), Černá na Šumavě and Boubín (Herink), Železná Ruda (Sak), Blovice (Maloch), Šumava (Zvěrinová), Chotěboř (Pavlíček), Zinnwald (Thümen — see our observation under Exsicc.), Rokycany (Maloch), Louny (Šubrt), Harachov (Sak), Mnichovice (Velenovský), Zruč (Perůtka), Orlické hory (Kašpar), Krkonovse (Kavina), Krokoneše-Labský dul (Pilát, Hartig), Třebon (Nešpor), Šumava — Kohout (Šimek), Boubín (Kavina), Rudohoří (Velenovský), Stemberk (Piskor), Brno (Hruby), Jihlava (Schwarz), Gräfenberg (Pilátová), Inovecké hory (Hruby, Vysoké Tatry (Pilát); *Eesti*: Tarrumaa (Lepik); *Finland*: Abo, Lemo, Wichtis, Tyrvis, Tammela (Karsten); *Germany*: Rachlau (Feurich), Pillnitz (Pieschel), Gross Winterberg, Augsburg, Paring (Killermann) Maria Eck, Oberammergau, Berchtesgaden, München Grafroth Stain (Allescher), Tölz, Brieg (Schroeter); *Poland*: Rubnik (Schroeter); *Sweden*: Uppsala (Lundell, Fries); *U.S.S.R.*: Wasjuganje, Kuznetsk (Krawtzew), Ural (Chomutsky), Kantulakt (Karsten), Minusinsk (Saccardo). Bourdot & Galzin (1928, p. 536) reports its presence in France from Jura (Konrad & Gilbert), Grande Chartreuse (M. Josserand), Haute Savoire (Crozals) and Valais (A. Laronde — France or Switzerland?). It is indicated in other countries by different authors, as follows: *Australia*, Victoria, Cooke (1892, p. 124) and Loddon River (Wallace) and Melbourne (Reader), both in Victoria, Cunningham (1950, p. 219); *Austria*, Magnus (1905, p. 185); *Bulgaria*, Dimitroff, in Ann. Univ. Sof. (ref. Rev. Appl. Mycol. 1936, p. 411); *Denmark*, O. Rostrup (1935, p. 30); *England*, Rea (1922, p. 617—618) and Stevenson (1886, p. 202); *Germany*, Silesia, Schroet, in Cohn (1889, p. 472); München in Allescher (1886 p. 71); *Italy*, Trento: Valle Lagarina (Cob.), Terzolas (Bres.), Emilia, Nizzardo (Barla in Bres.), Saccardo (1916, p. 987—988); *Japan*, Hokkaido and Honsyu, Imazeki and Toki (1954, p. 31); *Nepal*, Dhotbas, south of Chakure Lekh, 2550 m. alt., Balfour-Browne (1955, p. 194); *New Zealand*, Stevenson (1879, p. 136), Otago, South Island, Massee (1906, p. 5); *Norway*, Christiania (Oslo), Aker, Baerum, Asker, Borre, Tönsberg, Larvik, Hamar, Evenstad, Stai, Stor Elvdal, Lilleelvdal, Flisen, Lillehammer, Gola, and Sondre Froen, Blytt and E. Rostrup (1904, p. 121); *Sweden*, Jonsered, Floda, Alingsås and Tröllhattan, R. Fries (1888, p. 66); *U.S.S.R.* in Vanin's Vakin's, Jaczewski's, Woronichin's (Caucasus Mts.) and Thümen's (Siberia) works, as indicated by Jørstad & Juul (1939, p. 355); Archangel, Iaroslavsk, Ivanovo, Kalinin, Kirovskoye, Kurskoye, Kostrama, Leningrad, Mariinsk, Moscow,

Murmansk, Smolenskoye, Sverdlovsk and Tambov, Bondarzew (1953, p. 543); Siberia — Kuznetzk Distr. (by Krawtzew — 1930), Pilát (1932, p. 5).
4 — f. *rohrbacheri* (Kotl. & Pouz.) n. comb.: Czechoslovakia-Komořany and Praha, Kotlaba & Pouzar (1958, p. 100).

Pathological importance

S. borealis is responsible for the delignification of the host, producing the white and cuboidal wood-rot that was first reported by Hartig (1878) in spruce. The infection takes place when the spores arrive at a wound of the host, then a white mycelium develops in parallel strands or sheets (Fig. 8) which run through the wood radially and tangentially and later disappear, leaving small perforations by virtue of which the wood breaks into little cubes. The invasion zone will later be characterized by a greyish-green to greyish-violet color. Normally, the fruiting-bodies are found at the base of the trunk but the heartwood may be affected from the base to the top and present black vertical lines. According to Cartwright & Findley (1946) "the hyphae run across the grain of the wood, penetrating a number of tracheid walls in a line" and the hyphae are constricted where they pass through the cell walls.

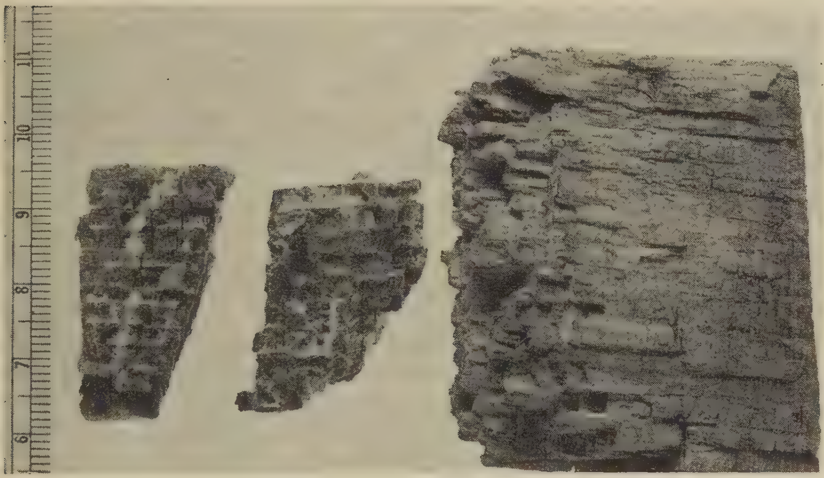

Fig. 8. Wood of *Tsuga canadensis* (L.) Carr. showing the cuboidal wood-rot produced by *Spongipellis borealis* (Fr.) Pat. The two first pieces present the white mycelium developed in parallel strands while one to the right shows the invasion zone where the wood appears with darker color.

Spongipellis borealis is not a very common fungus and for this reason has little economic importance except in Norway and the north of Finland.

Resumo

Spongipellis borealis (Fr.) Pat. é uma espécie típica do hemisfério norte que ocorre na América do Norte e Eurásia. É encontrada especialmente sôbre *Gymnospermae* podendo, entretanto, ser observada em *Angiospermae*. Apresenta grande variação morfológica que é, de certo modo, responsável pelas constantes mudanças desta espécie para diferentes gêneros.

As características macroscópicas fundamentais são: duplexidade do contexto, fibrosidade de ambas as camadas e ausência de conióforos no estrato superior. Microscòpicamente pode ser definida pela presença exclusiva de hifas generativas com ansas e, consequentemente, temos aquí estrutura monomitica. Estas hifas, entretanto, podem tornar-se espessas ou até mesmo sólidas, bem como, podem perder as ansas, simulando então o aspecto, o que levou Teston a considerar estas modificações como hifas esqueléticas. Cistídios são normalmente observados em pequena quantidade, tendo-se encontrado, porém, espécimes com grande número, enquanto outros demonstravem serem totalmente desprovidos dêste elemento. Setas e medas não foram observadas. Os basídios são alongados, ligeiramente clavados e os esporos variam de elipsoides a ovoides, apresentando, algumas vezes, pequeno apículo.

Em cultura desenvolve micélio branco, concèntricamente marcado por zonas leitosas e diáfanas. As hifas generativas apresentam grande abundância de ansas e no micélio aéreo, suas extremidades são contorcidas e cobertas por diminutos cristais. Clamidosporos são encontrados em grande abundância. Em culturas velhas podem a parecer hifas generativas espessadas com raras ansas do mesmo tipo daquelas presentes no corpo frutífero.

Espécie normalmente rara e poristo sem grande importância, exceto para a Noruega, Finlândia e Suécia, onde é mais comum e ataca as *Gymnospermae* promovendo a decadência cúbica do lenho.

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REVUE CRITIQUE DE LA MYCOLOGIE MEDICALE ENTRE 1946 ET 1956 EN FRANCE ET DANS L'UNION FRANÇAISE

par

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(22. V. 1958)

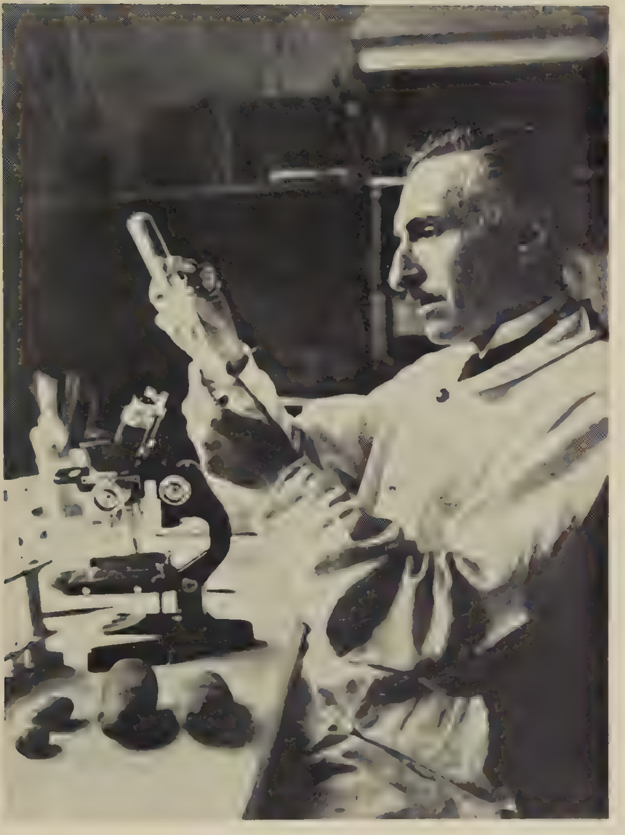
Avant de présenter cette revue des travaux mycologiques parus en France depuis les dix dernières années, il convient de rappeler la mémoire des meilleurs spécialistes français en Mycologie médicale disparus pendant cette période.: P. E. Pinoy (1873—1948) et M. Langeron (1870—1950) dont la vie et les remarquables travaux sont retracés dans cette même Revue (1, 2); E. Brumpt (1877—1951) (3), professeur de Parasitologie à la Faculté de Médecine de Paris, pionnier des recherches sur les mycétomes africains, fondateur des "Annales de Parasitologie"; H. Gougerot (1881—1955) (4), professeur de Dermatologie à la Faculté de Médecine de Paris, dont le nom reste étroitement lié à l'histoire des sporotrichoses humaines et animales, et J. Magrou (1883—1951), chef du Service de Physiologie végétale et de Mycologie de l'Institut Pasteur, éminent botaniste et mycologue dont l'enseignement des champignons pathogènes au cours de Microbiologie de l'Institut Pasteur a contribué énormément au développement de la mycologie médicale en France; l'œuvre scientifique de J. Magrou est retracée dans plusieurs notices biographiques (5, 6, 7); nous rappellerons ses travaux sur la génèse des massues actinomycosiques, la symbiose fongique des orchidées et de la pomme de terre, l'immunité chez les végétaux, l'action morphogène des vitamines sur les champignons.

Teignes et Dermatophytes

Les **dermatophytes** restent les mycoses les plus fréquentes. Mais, depuis 50 ans, la flore des champignons parasites des teignes, étudiée dans les remarquables travaux de Sabouraud s'est profondément modifiée. Pour la région parisienne, Rivalier et coll. (17, 28) constatent que la teigne tondante microsporique scolaire due à *Microsporum audouini* fréquente du temps de Sabouraud, est actuellement rare; par contre, la teigne d'origine animale due à *M. canis* est en progression; cette affection susceptible de guérir rapidement sans l'épilation radiothérapique nécessaire au premier type de teigne, comporte un effort prophylactique spécial portant sur les animaux d'appartement devenus plus nombreux dernièrement. Le nombre global de teignes trichophytiques est en diminution mais la flore est nettement modifiée; les espèces autochtones (*Trichophyton tonsurans*) sont devenues rares, cédant la place à *T. violaceum* importé d'Afrique du Nord pour la majorité des cas observés; la fréquence du favus dû à *T. schoenleini* demeure la même depuis des années, mais tandis que les foyers faviques autochtones sont aujourd'hui notablement raréfiés, des foyers nouveaux sont réalisés par l'apport de Nord-africains venant travailler dans la région parisienne. Dans la région du Nord, l'endémie teigneuse étudiée par HURIEZ, BIGUET, COCHET, MULLER & DOBY-DUBOIS (22) est restée relativement stable durant les dix dernières années et la fréquence de ces affections est loin d'être négligeable (714 cas.) Les formes cliniques observées sont essentiellement: microsporie (56%), favus (34%), trichophyties (10%). Du point de vue mycologique dans la microsporie, on a isolé *Microsporum canis* (277 souches), *Microsporum audouini* (102 souches) et *T. ferrugineum* (4 souches); dans le favus: *Trichophyton schoenleini* et dans les trichophyties: *Trichophyton tonsurans* (26 souches), *T. sabouraudi* (28 souches) et *T. violaceum* (7 souches).

Dans la région lyonnaise, la fréquence des divers dermatophytes étudiée par COUDERT (15) se rapproche des précédentes; dans la région marseillaise, RANQUE & TEMIME (26) sur 1.800 cas de teignes dépistés parmi 25.000 sujets examinés entre 1946 et 1956, constatent: 1) la grande fréquence des trichophyties à *T. violaceum* (78%), 2) la fréquence des formes frustes de ces teignes, en particulier chez les adultes qui peuvent constituer des porteurs inapparents, 3) la détermination quasi expérimentale du délai d'incubation: 1 mois pour *T. schoenleini*, 4 à 6 semaines pour *T. violaceum*; 4) les progrès de l'hygiène ont fait disparaître de cette région les teignes scolaires et favus autochtones. Le port de vêtements et de chaussures en caoutchouc ou en nylon a, dans une certaine mesure, favorisé la recrudescence des épidermophyties. Mais, sans ce fait capital qu'a constitué le transit des émigrants israélites, le problème des teignes ne se serait pas posé d'une façon particulière dans la région marseillaise.

MARGAROT (24), promoteur de l'utilisation de la lumière de Wood pour le diagnostic des teignes tondantes basé sur une expérience de 25 ans, souligne l'intérêt prophylactique de cette méthode dans les agglomérations d'enfants. RIVALIER (27) a décrit un nouveau dermatophyte, *Sabouraudites* (*Microsporum*) *praecox* qui a conservé en culture pendant 10 ans son caractère de produire rapidement de nombreux fuseaux allongés. MARCELOU (25) a étudié un *Trichophyton rosaceum* isolé d'un onyxis. Une blépharite provoquée par *Trichophyton mentagrophytes* a été observé par BESSIÈRE (8). Les teignes infantiles du Cameroun sont étudiées par COCHET & DOBY-DUBOIS (10), l'endémie teigneuse chez les enfants de race noire, relativement sévère, est caractérisée cliniquement par la prédominance nette des trichophyties (80%) sur les microspories (20%). Les favus, s'ils



J. MAGROU (1883—1951)
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existent, doivent être très rares. Du point de vue mycologique, la flore relativement monotone, n'est représentée que par quatre espèces: une variété africaine de *Microsporum audouini* et *Microsporum ferrugineum* agents des microspories; *Trichophyton soudanense* et *Trichophyton camerounense* n. sp. agents des trichophyties.

Les déficiences en facteurs de croissance vitaminiques de 34 souches appartenant à 17 espèces différentes de dermatophytes ont été étudiées par DROUHET & MARIAT en 1952 (18) sur des milieux dont la source d'azote était soit inorganique (nitrate ou sulfate d'ammonium), soit organique (asparagine, hydrolysat de caséine ou aminés purs). Les souches incapables de se développer en l'absence de vitamines sont: *Trichophyton tonsurans* (*T. crateriforme, T. acuminatum* et *T. sulfureum*), *T. violaceum* et sa variété *T. glabrum*. Ces souches demandent comme facteurs de croissance la fraction pyrimidine de la thiamine. En présence de pyrimidine sur milieu à base d'acides aminés, ces souches montrent les organes caractéristiques de fructification. *Trichophyton concentricum* est stimulé par la fraction thiazole de la vitamine B.

L'action des acides aminés sur la croissance et la morphogénèse de 12 espèces de dermatophytes est étudiée par DROUHET en 1952 (19). Seul *Trichophyton rosaceum* exige un acide aminé déterminé, l'histidine, facteur essentiel de croissance (20). La carnosine (β-alanyl-histidine) et l'histidyl-histidine peuvent remplacer l'histidine comme facteur de croissance. L'activité du premier dipeptide est voisine de celle de l'histidine tandis que l'histidyl-histidine est beaucoup moins active. L'azote aminé permet de réaliser un développement caractéristique, mais en présence d'un seul acide aminé, ces champignons se développent beaucoup plus lentement que lorsque un mélange de ces composés leur est fourni. Dans l'ensemble, les dermatophytes utilisent les acides aminés dans l'ordre préférentiel suivant: arginine et proline > acide glutamique > sérine > glycocolle > alanine > valine > leucine > phénylalanine > acide aspartique > tyrosine > histidine, isoleucine > thréonine > norleucine. Les acides aminés soufrés et le tryptophane ne sont pratiquement pas utilisés. La croissance maxima et la morphogénèse la plus complète sont obtenues sur certaines peptones. Le comportement de quelques dermatophytes sur le couple tyrosine-tirosinase est étudié par COUDERT & PRUNIÈRAS (14). La nutrition et les facteurs de croissance des dermatophytes sont traités amplement par DROUHET & MARIAT dans un rapport au Symposium sur la nutrition du 6ème Congrès International de Microbiologie de Rome (1955) (21).

CANDIDOSES ET CANDIDA

Pathologie — L'introduction des antibiotiques à large spectre a considérablement augmenté la fréquence des moniliases observées en pédiatrie (39, 41, 42, 50, 65), gynécologie (33, 53), dermatologie

(52, 56, 57, 60, 76), gastroentérologie (61, 68), pneumologie (51, 58) et hématologie (31, 32). Parallèlement à l'accroissement du nombre de cas, la gravité des manifestations pathologiques dues aux *Candida* en particulier à *C. albicans* a augmentée considérablement. LELONG et coll. (65) d'une part, DEBRÉ et coll. (41) d'autre part, signalent des cas mortels ou graves du muguet généralisé chez les nourrissons. LARROCHE (63) signale des bronchopneumonies mortelles massives et diffuses chez des prématurés. Certains cas même, sont signalés chez l'adulte après l'administration d'antibiotiques à hautes doses (50, 51). Une identification plus rapide des *Candida* a été mise au point à l'Institut Pasteur (49) tenant compte de leurs caractères morphologiques et physiologiques et en prenant pour base les travaux de LANGERON. Sur 342 souches de *Candida* isolées au Service de Mycologie de l'Institut Pasteur entre 1952 et 1956, *Candida albicans* s'est montré l'espèce le plus souvent rencontrée dans les prélèvements pathologiques (78,7%) suivie de *C. tropicalis* (7,6%), de *Candida* du groupe *krusei* (7,7%), de *C. pseudotropicalis* (4,4%) et de *C. guillermondi* (1,7%).

La collaboration entre le laboratoire et la clinique a permis dans de nombreux cas d'établir avec certitude l'étiologie fongique de diverses manifestations cliniques. Pour attribuer une signification pathologigue aux *Candida* isolés, trois éléments ont été pris en considération dans l'examen de laboratoire: 1) lieu du prélèvement (dans le sang, l'urine, le liquide céphalo-rachidien et dans tout foyer inflammatoire clos), la présence des *Candida* indépendamment de leur espèce et de leur nombre a une valeur pathologique certaine. Sur la muqueuse et les téguments les *Candida* peuvent exister à l'état saprophytique; 2) nombre de *Candida* isolés des lésions: l'existence d'une façon exclusive ou prédominante d'un grand nombre de *Candida* dans les lésions prend en général une signification pathologique; 3) espèce de *Candida*: l'isolement de *C. albicans* dans les lésions cutanées a une valeur pathologique certaine du fait que cette espèce est la seule du genre *Candida* qui ne se trouve pas à l'état saprophytique sur les téguments, mais seulement sur les muqueuses. Le rôle pathogène de *C. albicans* s'est montré d'une façon certaine dans 156 cas sur 269 où cette espèce a été isolée. Parmi ces cas dont les conditions étiopathogéniques sont analysées en détail (50) on remarque de nombreux cas de muguet généralisé à hémoculture positive et à localisation viscérale, tous consécutifs aux traitements antibiotiques et de nombreux cas d'onyxis avec périonyxis sans relation avec les antibiotiques. Les *Candida* autres que *C. albicans* considérés autrefois comme non pathogènes, produisent dans certaines conditions des manifestations pathologiques.

Ainsi, *C. tropicalis* et *C. pseudotropicalis* ont été trouvé responsables de manifestations bronchopulmonaires et *C. parakrusei* d'abcès souscutanés (49, 50). L'étude de l'étiologie et de la pathogénie des infections à *Candida* souligne le rôle joué par l'âge, le terrain, la maladie primaire, les facteurs endocriniens et les antibiotiques. En contraste avec la fréquence élevée des cas de muguet survenant après antibiotiques (78% des cas), les accidents cutanés postantibiotiques sont plus rares (20%). *In vitro*, MARSELOU & SEGRETAIN (66) font la preuve que les antibiotiques n'ont pas d'action sur la croissance des *Candida*. Les accidents à *Candida* au cours des traitements par les antibiotiques sont étudiés par de GRACIANSKY et coll. (52) dans une monographie. L'étude de nombreux cas de mycoses vaginales par GRASSET, SENÈZE & GAUTHIER (54) relève l'association avec une infestation vésicale et intestinale et la fréquence de l'atteinte conjugale clinique ou latente; malgré la rigueur apportée au traitement par de nombreux antifongiques, des récidives demeurent fréquentes et paraissent liées à certains états biologiques, (grossesse) ou aux associations bactériennes qu'il ne faut pas négliger. Les conditions favorisant la surinfection à *C. albicans* dans les hémopathies malignes sont étudiées par J. BERNARD et coll. (32). Les candidoses s'observent avec une fréquence particulière chez les leucémiques traités par des antibiotiques mais les auteurs rapportent des observations de muguet chez des malades on traités par ces produits, les uns recevant des hormones corticosurénales ou des antimétabolites, d'autres non traités.

Dans la langue noire, considérée autrefois comme une manifestation fongique dûe à un *Candida* particulier ("*C. linguae pilosae*"), plusieurs espèces de *Candida* (*C. albicans*, *C. tropicalis*, *C. pseudotropicalis*) associées souvent à des *Geotrichum* sont isolées et mises en évidence histologiquement dans les villosités linguales (38).

L'allergie à *Candida albicans* est étudiée par J. SCLAFER du point de vue clinique, diagnostic et traitement (71, 72, 73). Le rôle allergique de *C. albicans* s'étend non seulement à l'eczéma mais à beaucoup d'autres manifestations allergiques, dont il est responsable dans environ 10% des cas. Parmi les 114 malades retenus dans cette étude on relève 71 cas d'eczémas, 25 cas d'urticaires, prurigo, strophulus et oedèmes de Quincke, 41 cas d'allergies respiratoires (asthmes, rhino-sinusites, toux spasmodiques); 23 cas de céphalées et migraines. Parmi les manifestations plus rares sont surtout à noter les brûlures gastriques et vesico-urétrales. Ces lésions sont non seulement remarquables par leur variété mais encore par la fréquence de leur association chez un même malade et par leurs caractères évolutifs. L'éosinophilie sanguine modérée (5%) contraste avec l'éosinophilie plus élevée provoquée par les pneumallergènes. Le diagnostic biologique repose, d'une part, sur la découverte d'un foyer d'infestation mycosique et, d'autre part, sur l'utilisation d'un extrait de *Candida albicans*. La preuve de l'allergie est apportée autant par les tests eux-mêmes que par leur influence sur les symptômes.

Candidoses expérimentales

Les candidoses expérimentales ont fait l'objet de plusieurs études (30, 45, 70). Chez le jeune chien, malgré l'administration d'antibiotiques à fortes doses le régime carné ne permet pas l'installation d'une candidose digestive. Cette candidose en demeurant sans traduction clinique n'est obtenue qu'après substitution au régime carné d'un régime hyperglucidique. La dichloroxyquinaldine administrée *per os* à forte dose n'entraîne aucune variation du taux focal de levures contrairement à la nystatine (70). P. DE GRACINASKY et coll. (53) ont étudié l'influence des carences vitaminiques et des carences protidiques sur la réceptivité des rats blancs aux infections à *C. albicans*. Avec des doses faibles d'inoculum il a obtenu des infections plus marquées chez des animaux carencés en vitamines que chez ceux carencés en protides. C'est surtout la carence en vitamine B_2 qui augmente la réceptivité des animaux à l'infection à *Candida*.

Thérapeutique

La fréquence des infections à *Candida* et la gravité de certaines manifestations dues à *C. albicans* observées dernièrement, ont rendu nécessaire la recherche de produits antifongiques actifs car l'arsenal thérapeutique était limité. Les résultats thérapeutiques des chercheurs français obtenus avec la nystatine, polyène découvert par HAZEN & BROWN, sont parmi les premiers signalés dans la littérature (31, 41, 45, 55, 56); E. DROUHET (45, 46, 47), R. DEBRÉ, P. MOZZICONACCI, E. DROUHET, V. DROUHET & A. HOPPELER (41), J. BERNARD, G. MATHÉ & E. DROUHET (31) ont prouvé l'action favorable de la nystatine dans les infections graves à *Candida* survenant après antibiothérapie.

L'étude de l'action thérapeutique de la nystatine a été faite sur 46 cas d'infection géneralisée ou localisée à *C. albicans*, suivis par de nombreux contrôles mycologiques à l'Institut Pasteur (45, 46,47). Dans 13 cas, il s'agissait de candidoses généralisées avec muguet dont 3 à hémoculture positive et 3 avec des abcès sous-cutanés, 5 avec diarrhée et 2 avec vulvovaginite; dans 25 cas, il s'agissait de candidose localisée au tube digestif et dans les autres il s'agissait de candidoses cutanéo-muqueuses. L'administration de nystatine par voie orale et locale a été suivie de la disparition complète ou presque complète de *C. albicans* dans les divers prélèvements où le nombre des *Candida* était considérable et associé à des manifestations pathologiques (muguet, troubles digestifs, troubles toxiques, troubles urinaires, abcès, perte de poids, éruption cutanée). Bien que la résorption de la nystatine soit faible dans l'organisme, des résultats excellents ont été obtenus dans des cas de muguet généralisé avec hémoculture positive, uroculture positive, abcès sous-cutanés. Cette remarquable activité est fonction de la stérilisation du tube digestif, principal foyer de *Candida*; cette stérilisation entraîne une amélioration rapide de l'état général des enfants et la disparition des manifestations pathologiques de *Candida*. La géotrichose digestive nécessite des doses considérables de nystatine et un traitement prolongé (46). Les récidives quelquefois fréquentes ne sont pas dues à une résistance; elles proviennent soit d'un traitement insuffisant, soit de la persistance des conditions primaires qui favorisent la réapparition des *Candida*. BRET & BARDIAUX (33) ont obtenu la guérison de 20 cas de vaginite à *Candida* en quelques jours de traitement par introduction vaginale de 2 comprimés à 100.000 U. de nystatine. Les quelques récidives observées sont expliquées soit par l'auto-infection d'un foyer infectieux extra vaginal, cutané ou intestinal, soit par l'hétéro-infection conjugale.

En dermatologie, C. GRUPPER (55, 56, 57) a obtenu la guérison par la nystatine locale de nombreux cas d'onychomycoses à *C. albicans*, particulièrement rebelles à tous les traitements, ainsi que dans d'autres manifestations cutanées à *Candida*; dans les candidoses cutanéo-muqueuses buccales et perianogénitales, intertrigo, le traitement local a été suffisant. Dans les candidoses unguéales (31 cas d'onyxis avec ou sans périonyxis) le meulage des ongles atteints est indispensable pour faire pénétrer mieux la pommade à la nystatine. Dans les candidoses cutanéo-muqueuses superficielles généralisées, au traitement local, l'auteur ajoute le traitement par voie orale.

Candida

Les caractères morphologiques et physiologiques des *Candida* ont été étudiés par divers auteurs (29, 34, 35, 48, 49). 106 souches de *Candida* d'origine humaine sur 110 étudiées (44) exigent la biotine comme facteur essentiel de croissance. *C. pseudotropicalis* exige en plus de la biotine, l'acide nicotinique. Dans les *Candida* du groupe *krusei*, à l'exception de 4 souches auxo-autotrophes appartenant à l'espèce *krusei*, les autres souches dont les caractères sont proches de *C. parakrusei* ont des besoins vitaminiques multiples: biotine, thiamine, acide nicotinique, pyridoxine.

Une nouvelle espèce de *Candida*, *C. pseudotumoralis* isolée d'une candidose canine a été décrite par MORQUER et coll. (67).

ASPERGILLOSE

Dans les dernières années, un nombre important de cas d'aspergillose pulmonaire et surtout de formes chirurgicalement curables de cette affection ont été rapportés en France (78, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90). Les progrès récents dans la connaissance des localisations bronchopulmonaires des aspergilloses sont dûs au développement de la chirurgie pulmonaire et surtout à l'identification et à la description de l'aspergillome bronchectasiant par MONOD, PESLE & SEGRETAIN, (85, 86). L'aspergillome bronchectasiant signalé, pour la première fois par DÉVÉ en 1938 [1]) se définit et se limite du point de vue clinique par une localisation unique dans le poumon sain, du point de vue anatomo-pathologique par un développement dans une cavité bronchique dilatée à son contact et par sa non-pénétration dans la partie bronchique: il est posé sur la muqueuse; du point de vue mycologique, il se caractérise par une forme de souffrance et de résistance du champignon.

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[1]) DÉVÉ F. Une nouvelle forme anatomo-radiologique de mycose pulmonaire primitive. Le mega mycétome intra bronchectasique. *Arch. Med. Clin. App. Resp.* 1938, **13**, 337.

Les formes parasitaires des *Aspergillus* dans l'aspergillome bronchectasiant sont étudiées par SEGRETAIN. L'examen des coupes de 10 cas cliniques permet de préciser les formes filamenteuses et vésiculaires que prend le parasite dans l'énorme masse fongique développée à l'intérieur de la bronche, uniquement à sa surface; on note la rareté des fructifications asexuées du champignon. Dans le diagnostic biologique il faut souligner l'importance de l'examen histopathologique qui permet la détermination génerique et parfois spécifique du parasite; cette dernière n'est cependant assurée que par l'étude de la morphologie du champignon en culture. (93, 94) La deuxième forme d'aspergillose rencontrée est la bronchite aspergillaire. Enfin, la 3ème forme est l'aspergillose diffuse; dans ce cas, les *Aspergillus*, d'une agressivité particulière, se développent dans le tissu pulmonaire formant des colonies disséminées. Deux cas d'aspergillose nasale et sinusienne ont été observés par RENAULT, ARNAUD & PESLE; la symptomatologie de cette rare affection est celle d'une sinusite chronique. La trépanation du sinus montre la présence d'une masse mycélienne due à *Aspergillus*. (92). Une aspergillose cornéenne a été observée chez l'homme, et reproduite expérimentalement chez le lapin (80 bis).

TORULOSE (CRYPTOCOCCOSE) ET CRYPTOCOCCUS NEOFORMANS

La torulose n'est pas exceptionnelle en France. Plusieurs cas ont été décrits dans les dernières années (95, 96, 97, 98, 102, 103, 105). Dans un cas décrit par ALAJOUANINE, HOUDART & DROUHET (95) il s'agissait d'une torulose de la région sacrée avec méningite chronique; l'intervention chirurgicale et le traitement par l'actidione par voie intramusculaire et intrarachidienne ont arrêté l'évolution de la paralysie mais *C. neoformans* a été isolé constamment du liquide céphalo-rachidien; l'issue fatale est survenue 5 ans après. Dans un cas de torulose cutanée, (97) *C. neoformans* a été isolé de la peau et des crachats du malade, confirmant ainsi l'origine pulmonaire de cette mycose. L' association de la maladie de Hodgkin et de la torulose à point de départ cutané est décrite par DEBRÉ et coll. (98).

Un cas de torulose spontanée a été observé chez le cobaye par DEZEST (99). Une mammite à *Cryptococcus neoformans* chez la vache est décrite par SEGRETAIN, VERGE et coll. (105); l'injection d'actidione dans la mamelle a amené la stérilisation du lait, mais n'a pu influencer l'inflammation mammaire. Le présence de corps amyloïdes dans le système nerveux central et particulièrement dans la moëlle épinière, fait souvent présumer un diagnostic de torulose;

pour cela, SEGRETAIN & COUTEAU (104) ont étudié les caractères communs et différentiels qui distinguent les *Cryptococcus neoformans* des corps amyloïdes; la coloration à l'iode est la plus indiquée parmi les nombreuses colorations étudiées; elle colore les corps amyloïdes en brun et ne colore pas les *Cryptococcus.*

DROUHET & SEGRETAIN (100) ont étudié chez les variants muqueux (M) et lisse (S) de *C. neoformans* isolé d'un cas de méningite mortelle, les relations entre la capsule et la virulence. Les levures fortement capsulées, (souche M), sont beaucoup plus virulentes pour la souris et le cobaye que celles peu capsulées de la souche S. Dès 1950 ils ont déterminé par chromatographie sur papier et analyses chimiques, la composition du polyoside capsulaire, dont le xylose, le mannose et un acide uronique lié au mannose sont les principaux constituants; ces données ont été confirmées ultérieurement par EVANS (1952).

Les relations entre phagocytes et *Cryptococcus neoformans* sont étudiées par DROUHET & SEGRETAIN (101) qui montrent que le polyoside capsulaire en solution a une remarquable action inhibitrice sur la migration des leucocytes.

L'organisation structurale des colonies géantes avec variations sectorielles de *C. neoformans* a été étudiée par la technique des coupes histologiques en série et un rapport entre l'élaboration du matériel capsulaire et les modifications tinctoriales du matériel nucléaire a été établi. (101 bis).

HISTOPLASMOSE ET HISTOPLASMA

Aucun cas autochtone d'histoplasmose n'a pu être confirmé jusqu'à présent en France et toutes les enquêtes sur des sujets français testés à l'histoplasmine ont été négatives; mais plusieurs cas d'histoplasmose ont été observés chez des sujets ayant séjourné en Afrique ou dans d'autres régions endémiques. Ainsi, un cas d'histoplasmose pulmonaire bénigne a été observé chez un ingénieur français de retour d'un séjour aux Etats Unis et un cas d'histoplasmose disséminée mortelle chez un français ayant séjourné au Gabon (A.E.F.) (115); ce malade présentait des lésions buccales ulcératives, accompagnées d'une atteinte pluriviscérale avec hépatomégalie et lésions pulmonaires qui ont amené la mort du malade. En Afrique occidentale française et en Afrique équatoriale française, une vingtaine de cas d'histoplasmose à grandes formes ont été décrits depuis le premier cas signalé en 1945 par CATANEI & KERVRAN (106, 108, 109, 111, 115, 116, 119, 122, 123, 125). Dans cette histoplasmose africaine à grandes formes (5-18μ) on remarque des lésions cutanées et sous-cutanées (papules, nodules, gommes, abcès, ulcérations) à évolution lente, des gommes osseuses et des lésions viscérales responsables de l'issue fatale des malades (115). Dans tous ces cas on observe des lésions de type granulomateux, folliculaire, épithélioïde, etc. . . ., de cellules géantes contenant des histoplasmes de grande taille.

En A.E.F., dans la population noire, MERVEILLE et coll. (120) ont obtenu 10% de réactions positives. D'autres enquêtes africaines sont actuellement en cours. A Nancy, MELNOTTE (124) avait constaté des réactions positives à l'histoplasmine chez des travailleurs nord-africains, mais d'autres chercheurs n'ont pas pu confirmer de telles réactions chez des travailleurs originaires d'autres départements de l'Algérie.

Une histoplasmose spontanée cutanée, osseuse et ganglionnaire chronique à grandes formes a été observée par COURTOIS, SEGRETAIN, MARIAT & LEVADITI (110) chez des singes africains maintenus en captivité à l'Institut Pasteur. Une étude mycologique détaillée du champignon isolé a été faite par MARIAT & SEGRETAIN (123 bis); il est considéré comme une variété ou sous-espèce d'*Histoplasma capsulatum* se distinguant par une difficulté extrême de culture, un développement lent, un faible pouvoir pathogène.

Une étude comparative des phases mycélienne et levure de 18 souches d'*Histoplasma capsulatum* d'origine américaine et africaine est faite par DROUHET & SCHWARZ (114); à côté des petites formes classiques de 2μ qui constituent la majorité des éléments cellulaires de la phase levure, on observe de grandes formes de 6 à 17μ de diamètre non seulement chez des souches africaines, mais également chez certaines souches américaines, la proportion de ces éléments variant suivant les souches. La grande variabilité de la phase levure observée chez de nombreuses souches américaines et africaines contraste avec la constance de la phase mycélienne avec des macrospores tuberculées caractéristiques.

Le hamster doré s'est montré un excellent animal pour l'étude de l'histoplasmose expérimentale (112, 113) donnant une infection généralisée du système réticulo-endothélial avec une mortalité de 100% obtenue régulièrement en 6-8 semaines.

L'étude comparative de la morphologie parasitaire et de la virulence des souches américaines d'*Histoplasma capsulatum* et des souches africaines d'histoplasme a été effectuée sur le hamster doré et sur la souris (114). Le hamster doré se montre beaucoup plus sensible que la souris à l'inoculation des histoplasmes. La phase levure se dissocie chez l'animal en petites et grandes formes, ces dernières beaucoup plus fréquentes chez les souches africaines.

SPOROTRICHOSE ET SPOROTRICHUM

Cette mycose, considérée comme fréquente en France (entre 1906 et 1910, GOUGEROT (132) signalait plus de 200 cas) a disparu complètement durant les 10 dernières années; tout récemment, un cas a été décrit chez le chien (133) et un autre chez l'homme (136). Une sporotrichose expérimentale à allure chronique ou subaiguë avec orchite et lésions gommeuses des pattes a été obtenue chez le hamster doré (135). Dans cette infection expérimentale, diverses formes morphologiques de *Sporotrichum schencki* allant de la forme en navette classique à la forme asteroïde ont été observées dans les tissus. La phase levure a pu être obtenue dans un milieu liquide de composition connue, contenant des acides aminés, de la pyrimidine et de la biotine et agité à 37°C (131). Un milieu synthétique liquide ou gélosé contenant du sulfate d'ammonium, de la pyrimidine et de la biotine permet, en présence d'un mélange CO_2-air à 5% de CO_2, le développement de la phase levure de *S. schencki*. En présence d'air seul ou d'un mélange azote-air, ce même milieu ne donne que la phase mycélienne du champignon. La pyrimidine et la thiamine est indispensable à la croissance de *Sporotrichum schencki*, *S. beurmanni* et *S. tropicalis* (130). Sur 22 composés pyrimidiques étudiés, aucun ne s'est montré capable de remplacer la pyrimidine de la thiamine; quatre se sont avérés inhibiteurs. Le méthyl -2 dihidroxy- 4-6 phényl azo-5 pyrimidine est en particulier capable de provoquer une inhibition totale de la croissance de *Sporotrichum* à la concentration de 10^{-4}. La biotine est facteur stimulant de croissance pour *Sporotrichum schencki* et favorise sans la conditionner totalement, la formation de la phase levure.

BLASTOMYCOSE ET BLASTOMYCES

Aucun cas de blastomycose humaine n'a été signalé en France. Une étude des blastomycoses expérimentales du hamster doré (139) souligne l'intérêt expérimental de cet animal avec lequel on obtient facilement une généralisation de la maladie par voie intrapéritonéale; des formes massuées de *Blastomyces brasiliensis* ont été observées. La cytologie nucléaire de *B. brasiliensis* sous sa forme levure et mycélienne est étudiée par DROUHET & ZAPATER (137). Les formes levures sont multinucléées. La multiplication des levures suit un cycle évolutif passant par divers stades. En contraste avec la phase levure caractérisée par une grande richesse de matériel nucléaire, la phase filamenteuse présente peu de noyaux difficilement mis en évidence. La phase levure exige la thiamine pour son développement dans un milieu semi-synthétique, tandis que la phase filamenteuse est auxo-autotrophe.

CHROMOBLASTOMYCOSE

24 cas de chromoblastomycose ont été observés par BRYGOO (140) à Madagascar au cours des deux dernières années. Cliniquement, il s'agit de lésions végétantes, verruqueuses, sèches ou abcédées plus fréquentes chez l'homme. L'examen histologique est nécessaire et suffisant pour établir le diagnostic, permettant d'observer les

cellules fumagoïdes pathognomiques dans un processus inflammatoire chronique qui prend parfois l'aspect d'un tuberculose cutanée et même d'un épithélioma. La culture indispensable pour déterminer avec certitude l'espèce responsable a permis de trouver les espèces suivantes: *Phialophora pedrosoi* (5 souches), *Cladosporium* (*Hormodendron*) (5 souches), identifiées par G. SEGRETAIN à l'Institut Pasteur, qui leur consacre une étude mycologique détaillée.

MYCETOMES

Une importante recherche sur 100 cas de mycétomes du Sénégal et de la Mauritanie (141) a été faite par CAMAIN & SEGRETAIN en fonction du type de grain, de la morphologie du parasite et des modalités réactionnelles tissulaires qu'il détermine. D'après ces caractéristiques, on distingue 2 grands groupes de mycétomes: 1° les mycétomes actinomycosiques provoqués par *Streptomyces pelletieri* (32 cas), par *Streptomyces madurae* (7 cas) et par *Streptomyces somaliensis* (14 cas). Les deux premières espèces produisent des grains hématéiphiles, la 3ème des grains non hématéiphiles; 2° les mycétomes fongiques à grains noirs produits par *Madurella mycetomi* (42 cas) et à grains blancs produits par *Monosporium apiospermum* (5 cas).

Le diagnostic biologique de la maduromycose est étudié par SEGRETAIN (143); l'isolement du parasite est particulièrement important pour ce diagnostic à cause de la diversité des espèces responsables, de leur morphologie très peu caractéristique et de leur absence de pouvoir pathogène chez l'animal. Les caractères de souches de *Madurella mycetomi, M. grisea, Monosporium apiospermum* et *Phialophora jeanselmei* isolées des mycétomes africains sont décrits. F. MARIAT (142) étudie les caractères morphologiques et physiologiques des principaux actinomycètes responsables des mycétomes observés en A.O.F.: *Nocardia asteroides, N. brasiliensis, Streptomyces madurae, S. pelletieri* et *S. somaliensis*. Les caractéristiques des grains actinomycosiques de chaque espèce sont décrites en détail et permettent un diagnostic mycologique.

MYCOSE RETICULO-ENDOTHELIALE À PENICILLIUM MARNEFFEI

Chez les rats du bambou des Hauts Plateaux du Centre Viet-Nam, CAPONI, SUREAU & SEGRETAIN (144) ont trouvé une nouvelle espèce de *Penicillium* appelée *P. marneffei*, responsable d'une mycose du système réticulo-endothélial semblable à l'histoplasmose. Ce champignon très pathogène pour le hamster et la souris, se présente dans la phase parasitaire sous forme d'éléments fongiques d'environ 3 μ, ronds, ovalaires, séparés en deux par une cloison transversale.

ACTINOMYCOSE, ACTINOMYCES ET NOCARDIA

Il est classique d'introduire dans la mycologie médicale les actinomycoses, malgré que leurs agents n'appartiennent pas actuellement au groupe des champignons.

Les actinomycoses à Actinomycètes anaérobies sont fréquentes en France et de nombreuses observations cliniques leur sont consacrées. L'étude détaillée des caractères respiratoires, fermentaires, et d'autres caractères physiologiques a fait l'objet de nombreux travaux de PRÉVOT (157, 158, 159) et de son école; dans une monographie consacrée aux germes anaérobies on peut trouver des détails à ce sujet. PRÉVOT trouve dans l'actinomycose humaine *Actinobacterium israeli*, *A. meyeri*, *A. abcessus* et *A. cellulitis* et dans l'actinomycose canine et féline *A. baudeti*. La souche d'*Actinomyces bovis* décrite initialement par HARZ est pour lui un germe aérobie.

La physiologie des actinomycètes aérobies pathogènes a fait l'objet de plusieurs travaux de F. MARIAT (153, 152, 155, 156) qui apporte une remarquable contribution à la taxonomie de ces organismes. La qualité de l'alimentation azotée et carbonée influe sur la croissance, la pigmentation et la morphologie macroscopique des actinomycètes aérobies pathogènes étudiés. *Nocardia* (*Streptomyces*)*madurae* se distingue des autres espèces par l'utilisation de l'amidon, du mannitol et du xylose, *N. somaliensis* utilise très bien le maltose et diffère des autres espèces par la non utilisation de l'urée. De tous les actinomycètes pathogènes étudiés, *Nocardia lutea* et *Nocardia rubra* présentent une exigence vitaminique. La pyrimidine de la thiamine est exigée pour la croissance de ces deux espèces.

Le 4–4' diaminodiphényl sulfone (D.D.S.) inhibe le développement de quelques souches de *Nocardia brasiliensis*; elle inhibe la croissance de toutes les souches de *Streptomyces madurae* étudiées à la concentration de 15μg/ml.

Les caractères morphologiques, physiologiques et pathologiques des cinq principales espèces de *Nocardia* agents de mycétomes sont décrits (154); la morphologie parasitaire est d'une grande aide pour le diagnostic mycologique.

CLADOSPORIOSE

Cladosporium trichoides s'est montré l'agent d'une mycose cérébrale à abcès multiples, à évolution fatale (163). Les caractères de la souche obtenue en particulier la formation de vrilles sur le milieu de Czapek sont étudiés (164). La morphologie de ce champignon se rapproche de celle décrite par GARCIN et coll. (162) dans le cas d'une mycose cérébrale semblable, mais où la culture du champignon n'a pu être obtenue.

MISCELLANEES

Un cas de céphalosporiose humaine a été décrit par COUTELEN et col. (166) et une revue critique est faite à ce propos. MORQUER, Lombard & Berthelon (170) observent chez des porcs de la région d'Oran (Algérie) des adénites caséeuses provoquées par *Geotrichum candidum*. Le pouvoir pathogène expérimental sur divers animaux s'est montré nul (171). Cochet (165) étudie la flore intestinale de divers rongeurs sauvages et trouve de nombreux *Candida, Geotrichum, Trichosporon, Saccharomyces guttatula* . . .

La nature et la densité de la flore mycologique dans l'atmosphère de Paris au cours d'une année a fait l'objet d'une étude de Pasteur Vallery-Radot, Segretain, Halpern & Domart (172).

L'étude des besoins vitaminiques de quelques mucoracées pathogènes montre que la thiamine ou le thiazole et la pyrimidine réunies sont indispensables à la croissance de *Lichtheimia* (*Mucor*) *italica* et *L. corymbifera* (168). L'association du propionate et du lauryl sulfate de sodium augmente l'activité fongistatique sur *C. albicans* et sur les dermatophytes (169) de mêmes composes employés isolément. Une revue d'ensemble traite les antifongiques et la thérapeutique actuelle des mycoses (167).

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DER HEUTIGE STAND DER MEDIZINISCHEN MYKOLOGIE IN DER TÜRKEI

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5 Jahre Tätigkeit in Ankara haben uns immer wieder die Bedeutung der mykotischen Infektionen in unserem Krankengut vor Augen geführt. Sobald ein arbeitsfähiges mykologisches Laboratorium an der Klinik eingerichtet worden war, wurden von allen die Klinik mit Pilzerkrankungen aufsuchenden Patienten systematisch Kulturen angelegt, um einen Überblick über die Häufigkeit der einzelnen pathogenen Hautpilze zu erlangen. So übersehen wir heute seit Juni 1953 bis Ende 1957 1003 gelungene Kulturen. Insgesamt kamen 3007 Kranke mit Pilzerkrankungen (bei 1759 positiven mikroskopischen Befunden) in diesem Zeitraum zur Beobachtung, das sind etwa 11,5 % aller in diesen Jahren die Klinik aufsuchenden Hautkranken. Darin sind aber 240 Fälle mit Pityriasis versicolor und ein Fall mit Erythrasma eingeschlossen, so daß für die Anlegung einer Kultur 2766 Fälle von Pilzerkrankungen übrig blieben. Das bedeutet, daß etwa 36 % aller angelegten Kulturen positiv ausfielen. Dieses Ergebnis ist nicht sehr hoch, doch ist zu bedenken, daß wir bei der Beschaffung des Materials für Nährböden oft grösste Schwierigkeiten hatten und damit sehr sparsam umgehen mussten. So war es oft unmöglich das zu untersuchende Material auf eine grössere Anzahl von Platten der verschiedensten Nährböden auszusäen, ein Vorgehen, das für die Erreichung einer grossen Anzahl positiver Kulturen unbedingt notwendig ist. Immerhin erlaubt die Anzahl der gelungenen Kulturen doch einen grossen Überblick über die in der Türkei vorkommenden pathogenen Pilzstämme zu gewinnen. Wir bemühten uns auch die Kulturergebnisse anderer Autoren, die innerhalb der Türkei sich mit der Frage der hier vorkommenden Pilzerkrankungen befassten, zu erfassen und es soll nun mit Hilfe dieser Forschungsergebnisse und unserer eigenen Untersuchungen versucht werden ein Bild der hiesigen Pilzerkrankungen und ihrer Erreger zu entwerfen.

Im Folgenden werden die Ergebnisse unserer Untersuchungen nach dem klinischen Bild geordnet dargestellt.

1. Epidermophytien

Noch MARCHIONINI weist mehrfach darauf hin, daß besonders in Zentralanatolien intertriginöse Epidermophytien wenig verbreitet sind und die interdigitalen an Händen und Füssen sogar nur bei einem kleinen Teil der städtischen Bevölkerung, hauptsächlich der höheren Stände und der in Ankara wohnenden Ausländer vorkommen. MARCHIONINI begründet das mit dem Fehlen der Strandbäder einerseits, die ja bei der Übertragung der Infektion in Europa und Amerika eine entscheidende Rolle spielen, andererseits mit ethnographischen Besonderheiten der türkischen Landbevölkerung, die einer Ausbreitung dieser Erkrankung hinderlich sind.

In der Tat finden wir in der älteren türkischen Literatur nur wenig Hinweise auf das Vorkommen von Epidermophytien und der Kultur ihrer Erreger. So berichtet erstmals BEHÇET aus Istanbul 1925 über eine Epidermophytie, aus der das *Trichophyton* (*Epidermophyton*) *rubrum* CASTELLANI isoliert werden konnte. 1930 kommt BEHÇET noch einmal auf diesen Dermatophyten zurück. Mit der Kultur der pathogenen Hautpilze beschäftigte sich in den letzten Jahren vor allem UNAT, dessen Krankenmaterial vorwiegend aus Istanbul und dessen Einzugsgebiet stammt. Die Arbeiten von UNAT betreffen aber mehr die Methodik der Pilzkulturen und geben keinen Einblick in die Klinik der Pilzerkrankungen, vor allem nicht in die Lokalisation, Verteilung auf Geschlechter, auf den städtischen und ländlichen Anteil der Bevölkerung u. ä. Fragen. Wir entnehmen seinen Arbeiten, daß ihm die Kultur von *Trichophyton* (*Epidermophyton*) *rubrum* CASTELLANI, *Trichophyton gypseum* (*Epidermophyton* KAUFMANN-WOLF, *Trichophyton interdigitale* PRIESTLEY) gelungen sei. Leider gibt der Autor keine Verhältniszahlen über die Häufigkeit der einzelnen Stämme an.

Nun ist aber speziell in Zentralanatolien im Krankengut der Hautklinik Ankara insofern in den letzten Jahren ein Wandel eingetreten, als die Zahl der Epidermophytien gewaltig zugenommen hat. Für die Ankaraner Hautklinik kamen TAT & ERBAKAN für die Jahre 1950—1954 auf eine Gesamtzahl von 168 Fällen von Epidermophytia inguinalis und 557 Fällen von Epidermophytia palmaris et plantaris. Diese Zunahme von Epidermophytien gerade in Zentralanatolien, die im *Gegensatz* zu den seinerzeitigen Beobachtungen MARCHIONINI's steht, erregte unser besonderes Interesse und wir versuchten dafür die Gründe zu finden. Wir haben an anderer Stelle gezeigt, daß die Epidermophytien im gesamten Krankengut der Universitäts-Hautklinik Ankara im Jahre 1946 nur 0,49 % ausmachten, während sie in den Jahren 1953, 1954 und 1955 2,51 %, 3,72 % und 4,67 % betrugen, also eine deutliche Zunahme zeigten. Wir konnten ebenso zeigen, daß diese Zunahme nicht nur das Krankengut aus den Großstädten betraf, sondern daß die Epidermophytien auch unter der Provinzbevölkerung und unter der bäuerlichen Bevölkerung ebenso im Vormarsch begriffen sind. Die Ausbreitung dieser Erkrankungen ist ein Zeichen einerseits der zunehmenden Verstädterung der Bevölkerung, andererseits ein Zeichen des Eindringens unhygienischer Fußbekleidung in Form von Gummigaloschen auch in die kleinsten anatolischen Ortschaften und eine damit zunehmende Unhygiene der Fußpflege. Gerade die Verstädterung der Bevölkerung und das Vordringen billiger und unhygienischer Fußbekleidung, die aus dem Ausland importiert wird, nehmen in den letzten Jahren rapid zu und sind ein gutes Beispiel dafür, wie Änderungen der Lebensgewohnheiten und der Bekleidung dem Vordringen einer früher kaum vorkommenden Infektionserkrankung Vorschub leisten.

Wir beobachteten nun in den Jahren 1953—1957 unter unseren Kranken in Ankara insgesamt 1537 Fälle, die klinisch einer Epidermophytie (seltene Fälle von Epidermophytia inguinalis und vorwiegend Epidermophytia palmaris et plantaris) entsprachen und zwar waren es 637 Frauen und 900 Männer. Bei 750 Fällen wurde der Pilznachweis mikroskopisch erbracht, bei den anderen Fällen wurde die Diagnose klinisch, durch Trichophytintest und rückschliessend aus dem antimykotischen Therapieerfolg gestellt. Die meisten Kranken, bei denen mikroskopisch Pilze nicht nachgewiesen werden konnten, hatten auswärts bereits eine Behandlung durchgemacht. Wir züchteten nun aus unseren Epidermophytiefällen 262mal das *Epidermophyton floccosum* (HARZ) LANGERON et MILOCHEVITCH (*Epidermophyton inguinale* SABOURAUD), 133mal das *Epidermophyton interdigitale* PRIESTLEY (*Epidermophyton interdigitale* KAUFMANN-WOLF) und 41mal das *Trichophyton* (*Epidermophyton*) *rubrum* (CASTELLANI) SABOURAUD. Das Häufigkeitsverhältnis der gefundenen Erreger entspricht etwa dem, das wir bereits früher an einem kleineren Material feststellen konnten, nur zu Gunsten einer Verschiebung des *Epidermophyton interdigitale* PRIESTLEY, das nun häufiger als das *Trichophyton rubrum* (CASTELLANI) SABOURAUD anzutreffen war. Das *Epidermophyton floccosum* herrscht also als Erreger der Epidermophytien Zentralanatoliens weitaus vor und zwar auch als Erreger der Fußmykosen. Es soll hier nicht weiter auf die Vergleiche mit den Züchtungsergebnissen in anderen Ländern eingegangen werden, doch denkt man z.B. an die Ergebnisse, die in Deutschland GÖTZ in Hamburg, GRIMMER in Berlin oder PFISTER in Freiburg veröffentlichten, so herrscht in Zentralanatolien als Erreger der Epidermophytien gleichsam noch ein ,,altmodisches'' Pilzspektrum vor. Daß wir aus Fußmykosen auch 2mal das *Trichophyton violaceum* SABOURAUD und einmal das *Microsporon canis* BODIN isolierten, sei noch vermerkt. Bezüglich der anderen Fragen der Epidemiologie der Epidermophytien in Zentralanatolien dürfen wir auf unsere früheren Ausführungen verweisen.

2. Die Kopfpilzerkrankungen

Kopfpilzerkrankungen gehören im zentralanatolischen Krankenmaterial unserer Hautklinik zu den häufigsten Formen der Pilzerkrankungen, wenn auch die einzelnen klinischen Formen in sehr unterschiedlichen Prozentsätzen dabei vertreten sind. MARCHIONINI & TOR fanden seinerzeit unter ihrem Material den Favus weit überwiegend und betonen, daß die Mikrosporie äusserst selten sei. 16 Jahre später fanden TAT & ERBAKAN in unserem Krankenmaterial der Jahre 1950—1954 1156 Kopfpilzerkrankungen, die klinisch sich auf folgende Pilzerkrankungen aufteilten: 569 Fälle von Favus, 46 Fälle von Trichophytia profunda capillitii, 351 Fälle von Trichophytia superficialis capillitii und 190 Fälle von Microsporia capillitii.

Soweit aus anderen türkischen Landesteilen Untersuchungen vorliegen, kommen nur die Ergebnisse von UNAT in Betracht, der in Istanbul aus Haaren folgende Pilzstämme züchten konnte: *Trichophyton Schönleini*, *Trichophyton violaceum*, *Microsporon canis* und *Microsporon audouini*, *Trichophyton sabourauditi*, *Trichophyton album* und *Trichophyton mentagrophytes*. Die drei erstgenannten waren dabei am häufigsten vertreten. In einer weiteren Arbeit führt UNAT an, daß er in Istanbul aus Haaren und Schuppen bei Kopfpilzerkrankungen bei 107 Fällen 61 positive Kulturen erheilt und zwar 26mal *Trichophyton violaceum*, 21mal *Microsporon canis*, 11mal *Trichophyton Schönleini*, 2mal *Microsporon audouini* und einmal *Trichophyton sabourauditi*.

Wertvolle Untersuchungen über die Pilzstämme bei Kopfpilzerkrankungen aus Zentralanatolien liegen von MARCHIONINI & GÖTZ vor. Ihnen standen 108 Haarproben zur Verfügung, von denen 8 mikroskopisch und kulturell negativ waren. Von den restlichen 100 Proben erzielten sie in 96 % positive Kulturen, gewiß ein ausgezeichnetes Ergebnis. Diese isolierten Pilzarten betrafen 78 Stämme *Achorion Schönleini*, 2 Stämme *Achorion violaceum* BLOCH, 2 Stämme *Trichophyton faviforme album*, ein Stamm *Trichophyton faviforme ochraceum*, 2 Stämme *Trichophyton violaceum* BLOCH und 12 Stämme *Microsporon lanosum*. Interessant ist, daß diese Autoren bei 3 Patienten jeweils 2 Pilzstämme isolieren konnten und zwar je einmal *Achorion Schönleini* und *Microsporon lanosum*, *Achorion Schönleini* und *Trichophyton faviforme album* und *Achorion Schönleini* und *Trichophyton violaceum* BLOCH. MARCHIONINI hat sich auch um die Klarstellung der Epidemiologie und Pathogenese des Favus in Anatolien durch seine statistischen und ethnographischen Studien sehr verdient gemacht.

Nun betrug im Krankenmaterial der Ankaraner Hautklinik in den Jahren 1953—1957 die Zahl der Kopfpilzerkrankungen 879 Fälle, die sich folgendermassen nach ihrem klinischen Befund diagnostizieren liessen: Trichophytia superficialis et profunda capillitii 480 Fälle, Favus 328 Fälle und Mikrosporie 71 Fälle.

Unsere Kulturergebnisse bei den Trichophytien des Kopfes ergaben als Haupterreger in 180 Fällen das *Trichophyton violaceum* BLOCH, ein gewiß sehr interessantes Ergebnis. Doch war dieser Pilz auch unter den Fällen von UNAT aus Istanbul der häufigste Erreger bei der Kopfpilzerkrankung, während MARCHIONINI & GÖTZ ihn unter ihrem Material nur 2 mal fanden. Doch mag dies daran liegen, daß bei der Sammlung des Kulturmateriales hauptsächlich auf Favus Wert gelegt wurde. Als weiteres sehr interessantes Ergebnis unserer Kulturen von Fällen mit Trichophytie des Kopfes muß hervorgehoben werden, daß wir das *Trichophyton mentagrophytes*, das heute ja von vielen Systematikern dem *Epidermophyton interdigitale* KAUFMANN-WOLF, resp. dem *Trichophyton interdigitale* PRIESTLEY synonym gestellt wird, in 46 Fällen aus Schuppen und Haaren des Kopfes züchten konnten und desgleichen in 2 Fällen das *Trichophyton rubrum* (CASTELLANI) SABOURAUD. Diese sonst so typischen Epidermophytieerreger können also auch in den Haaren des Kopfes das Bild der Trichophytie hervorrufen.

Das *Trichophyton violaceum* SABOURAUD wird heute besonders von amerikanischen Autoren (z.B. BLANK in Montreal) dem *Achorion violaceum* BLOCH synonym gestellt. Für unsere Verhältnisse muß jedenfalls darauf hingewiesen werden, daß das klinische Bild in allen Fällen, aus denen diese Erreger gezüchtet werden konnten, nicht dem Favus, sondern der Trichophytie und zwar vorwiegend der Trichophytia profunda capillitii entsprach.

Unsere Fälle von Favus waren fast alle mikroskopisch positiv. Bei den wenigen Fällen, die mikroskopisch und kulturell negativ waren, handelt es sich durchwegs um ältere Personen, die die typische Favusalopecie hatten und bei denen noch einige Schuppen klinisch den Verdacht erregten, daß vielleicht noch Reste des Pilzes vorhanden seien. Soweit Kulturen vorgenommen werden konnten, züchteten wir in 290 Fällen das *Achorion Schönleini*. MARCHIONINI & GÖTZ haben die klinischen Erscheinungsformen des Favus in Zentralanatolien eingehend geschildert. Wir möchten nur betonen, daß wir diese von den Autoren geschilderten Formen immer wieder beobachteten, auch Fälle mit Körperfavus, darunter den eines 9jährigen Mädchens mit ganz extrem starkem Befall des ganzen Körpers (Abb. 1). In seiner Ausdehnung übertraf er noch den erst kürzlich von DOSTROVSKY, SAGHER & RAUBITSCHEK veröffentlichten Fall.

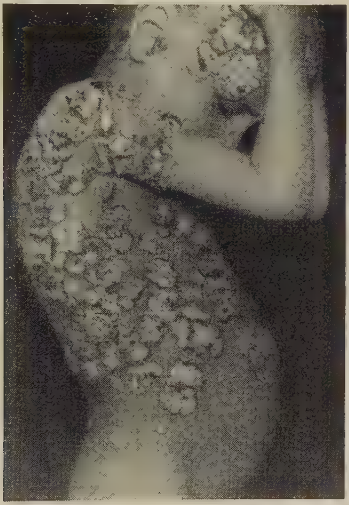

Fig. 1. Favus generalisatus bei einem 9jähr. Mädchen.

Wie auch MARCHIONINI & GÖTZ, fanden wir kulturell als Erreger des Favus auch nur das *Achorion Schönleini*, konnten jedoch Doppelinfektionen, obwohl wir unsere Aufmerksamkeit darauf richteten, nicht nachweisen.

Die Mikrosporie war als klinisches Erscheinungsbild unter unserem Krankenmaterial nicht so selten, wie es MARCHIONINI & TOR noch angeben. Aber 71 mit Fällen im Gesamtkrankengut der genannten Jahre kann man sie auch nicht als häufig bezeichnen. Der mikroskopische Pilznachweis gelang bei 70 Fällen. Bei 61 Fällen züchteten wir das *Microsporon canis* BODIN (*Microsporum lanosum* SABOURAUD). Den gleichen Erreger fanden MARCHIONINI & GÖTZ bei 12 ihrer Fälle, weiters herrschte er auch in den UNAT'schen Züchtungsergebnissen unter den gefundenen Microsporonarten vor. Aber während UNAT in seinem Istanbuler Material noch ganz vereinzelt das *Microsporon audouini* fand, fehlt dieser Erreger dem Ankaraner Material völlig. Im übrigen müssen wir auch hier MARCHIONINI & GÖTZ beistimmen, wenn sie bemerken, daß es Übergänge im klinischen Bild der Mikrosporie zur Trichophytia superficialis capillitii gibt, so daß die Diagnose Mikrosporie nicht immer rein klinisch auf den ersten Anhieb gestellt werden darf, sondern das mikroskopische Präparat herangezogen werden muß.

3. Die Trichophytia superficialis corporis und die Trichophytia profunda barbae.

TAT & ERBAKAN hatten in dem Krankenmaterial der Jahre 1950—1954 an der Ankaraner Hautklinik 170 Fälle, die klinisch einer Trichophytia superficialis corporis entsprachen, weiters im gleichen Zeitraum 30 Fälle mit Trichophytia profunda barbae. Über die Häufigkeit dieser Erkrankungen im Material der Kliniken anderer Landesteile liegen uns keine Unterlagen vor. Man kann nur aus den Arbeiten von UNAT entnehmen, daß er bei seinem Istanbuler Material aus Hautherden das *Trichophyton violaceum*, *Trichophyton sabourauditi* und *Trichophyton album* züchtete. Zahlen über die Häufigkeit dieser Stämme in Herden von Trichophytia superficialis corporis und Trichophytia profunda barbae liegen nicht vor.

Im Material der Ankaraner Hautklinik der Jahre 1953—1957 fanden sich 312 Fälle mit Trichophytia superficialis corporis und Trichophytia profunda barbae. Der häufigste Erreger war auch hier das *Trichophyton violaceum* BLOCH. In 7 Fällen bei Mikrosporie des Kopfes fanden sich auch Herde am Stamm unter dem Bilde einer Trichophytia superficialis, aus denen das *Microsporon canis* BODIN gezüchtet werden konnte. Auf vereinzelte Fälle von Körperfavus wurde schon verwiesen.

4. Onychomykosen

Hier steht uns nur Material aus der eigenen Klinik zur Verfügung. Teilübersichten über die Züchtungsergebnisse aus Nagelmykosen enthalten unsere früheren Mitteilungen über die Epidermophytien Zentralanatoliens und eine Mitteilung von TAT. Heute verfügen wir im Material der Klinik aus den Jahren 1953—1957 über 97 Fälle von Pilzerkrankungen der Nägel. 29 davon betreffen reine Onychomykosen, der Rest Mitbefall der Nägel bei Epidermophytien, Trichophytien und Favus anderer Körpergegenden. Kulturell gelang es uns aus Nägeln 19mal das *Epidermophyton floccosum* (HARZ) LANGERON et MILOCHEVITCH, 12mal das *Trichophyton interdigitale* PRIESTLEY, einmal das *Trichophyton rubrum* (CASTELLANI) SABOURAUD, 3mal das *Trichophyton violaceum* SABOURAUD und 3mal das *Trichophyton Schönleini* zu züchten. Die typischen Epidermophytieerreger überwiegen als Ursache der Nagelerkrankung weitaus.

5. Saprophytäre Pilzerkrankungen

Das Erythrasma fehlt in Zentralanatolien fast völlig. Jedenfalls fanden wir nur ganz vereinzelt einmal einen Fall. Hingegen ist die Pityriasis versicolor häufiger zu beobachten, jedoch nur in ihrer saprophytären Form, nicht in der parasitären Form der reinen Tropen. Unsere in den Jahren 1953—1957 beobachteten 240 Fälle betrafen 150 Männer und 90 Frauen. Klinische Besonderheiten sind nicht zu berichten.

1939 beobachtete BEHÇET einen Fall von Piedra in Istanbul. Weitere Beobachtungen dieser Haarerkrankung liegen bisher aus der Türkei nicht vor.

6. Blastomykosen

Die oberflächliche Form der Hefeerkrankungen der Haut, die Erosio interdigitalis blastomycetica, erscheint in unserem Krankenmaterial sehr selten. Innerhalb der letzten 5 Jahre beobachteten wir an unserer Klinik nur 4 Fälle, aus denen *Candida albicans* gezüchtet werden konnte. Das seltene Erscheinen dieser Erkrankung unter dem klinischen Patientenmaterial besagt jedoch nicht, daß diese Infektion nicht häufiger vorkäme. Die harte, genügsame anatolische Landbevölkerung wird wegen einer derartig relativ geringfügigen Läsion nicht die Klinik aufsuchen. Wir züchteten die *Candida albicans* noch 16mal aus anderen pilzverdächtigen Hautläsionen, aber wir gewannen den Eindruck, daß dieser Erreger in diesen Fällen lediglich eine sekundäre Begleiterscheinung war.

Tiefe Blastomykosen sind innerhalb des türkischen Raumes in wenigen Fällen beobachtet worden. Der erste Fall scheint von BEHÇET in seinem Lehrbuch der Hautkrankheiten 1940 erwähnt zu sein. 1946 beschreiben GALATAK & GÜRÜN einen Fall von Blastomykose, doch war es uns nicht möglich in die Originalarbeit Einblick zu nehmen. Ein weiterer Fall von Blastomykose wurde unter der Bezeichnung Cryptococcosis 1953 von SOYSAL, UNAT & TAKSINOĞLU veröffentlicht. Der Fall kam zur Sektion und neben dem klinischen Erscheinungsbild der Haut, das dem GILCHRIST'schen Typ entsprach, fand sich eine Reihe innerer Organe befallen, u.a. auch das Gehirn. Die Autoren bestimmten den gefundenen Erreger als *Cryptococcus neoformans* (SANFELICE 1894) VUILLEMIN 1901.

Der 1953 von KINACIGIL veröffentlichte Fall einer Blastomykose entsprach hingegen dem Typus BUSSE-BUSHKE. Der 4. Fall einer

Blastomykose wurde 1953 von GÖKSAN veröffentlicht. Der 45 Jahre alte Kranke stammte aus der Gegend von Diyarbakir und das Bild entsprach klinisch dem GILCHRIST-Typ. Röntgenologisch fanden sich bei diesem Fall eine Deformation des linken Caput humeri und eine lokale Periostitis der rechten Tibia und Fibula.

Ergänzend sei hinzugefügt, daß ARISAN die Häufigkeit des Vorkommens von *Candida albicans* in Vaginalabstrichen untersuchte. BARLAS & AKYOL berichteten weiter über einen Fall pulmonärer Moniliasis.

7. Seltenere tiefe Mykosen

Berichte über das Vorkommen von Histoplasmose stammen erst aus dem letzten Jahrzehnt. Über die erste Beobachtung eines Falles von Histoplasmose berichtete 1945 SAĞLAM in der türkischen Literatur und 1946 in der Schweizer Medizinischen Wochenschrift. Nachdem nun auf dieses Krankheitsbild in der Türkei die Aufmerksamkeit gelenkt worden war, folgten Berichte über weitere Fälle, so 1950 von KAMILE MUTLU und 1951 von SÖKMEN, deren Fälle aus dem Ankaraner Krankenmaterial stammten. Es handelte sich bei allen Fällen um *Histoplasma capsulatum*. SIRMAN führte bei einer grösseren Gruppe von Patienten mit den verschiedensten anderen Erkrankungen die Histoplasminreaktion durch und fand bei 4,3 % der Probanden eine positive Reaktion. Doch sind weitere klinisch sichere Fälle bis heute nicht bekannt geworden.

Auch die Sporotrichose gehört in der Türkei zu den seltenen Krankheitsbildern, obwohl UNAT angibt, daß sie seit langer Zeit in der Türkei bekannt sei. Doch bleibt er dafür die literarischen Belege schuldig. Sichere Fälle mit dem Nachweis des *Sporotrichum Schenkii* als Erreger sind in der Literatur aus der Türkei nur 2 vermerkt. 1924 berichteten EKREM BEHÇET & KEMAL über einen Fall und UNAT bringt in seiner Mykologie einen weiteren Fall von lymphangitischer Sporotrichose bei einem Mann, den URUS beobachtete, der jedoch scheinbar sonst nicht publiziert wurde. An unserer Klinik beobachteten wir bei einer Frau eine klinisch und histologisch typische Sporotrichose.

In den letzten Jahren wurde in der Türkei der erste Fall einer Rhinosporidiosis beschrieben. Es handelt sich um ein 12jähr. Mädchen aus Sivas, das einen leicht rot gefärbten polypenartigen Tumor in der rechten Nasenhöhle hatte, der auch zur Knochendestruktion geführt hatte. Die histologische Bearbeitung dieses Falles stammt von GÖKSAN, während ATAV, GÖKSAN & URAL zusammenfassend über den Fall berichteten und als Erreger das *Rhinosporidium seeberi* feststellten.

Nicht allzu selten fanden wir unter dem Krankenmaterial unserer Klinik Fälle mit Madura-Fuß. Schon MARCHIONINI hatte mehrfach auf das Vorkommen dieser schweren destruktiven Erkrankung aufmerksam gemacht, auch unter der Bezeichnung Aktinomykose davon Abbildungen gebracht. Wir beobachteten in den Jahren

1953—1957 3 Fälle, bei denen aus dem Fisteleiter mikroskopisch kleine weiße Pilzdrusen nachweisbar waren. Auch ihr histologischer Nachweis im Gewebe wurde geführt, doch gelang leider nicht die Kultur, so daß die nähere Bestimmung des Erregers nicht möglich war. MARCHIONINI hat darauf hingewiesen, daß das Barfußlaufen der Landbevölkerung Anlass zu Infektionen bietet. Die in Zentralanatolien zu starke Überweidung der Steppe durch Schafe und Ziegen führte zu einer unverhältnismässig starken Zunahme dorniger und stachliger Pflanzen, die von dem Vieh nicht abgeweidet werden, so daß Gelegenheit zu Fußverletzungen dauernd gegeben ist. Aus dem gleichen Grund ist in unserem Krankenmaterial das Erysipel der Füsse häufig zu beobachten und mit ihm oft mächtige Elephantiasis nostras der unteren Extremitäten (Abb. 2).

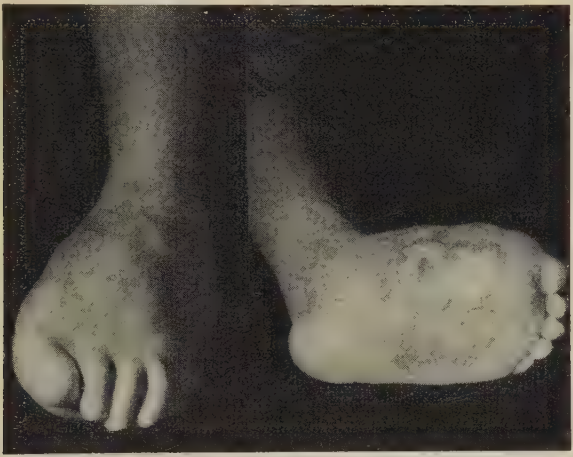

Fig. 2. Mycetom bei einem anatolischen Bauer.

Auch Aktinomykosen sowohl anderer Körperstellen als auch der inneren Organe sind nicht selten zu beobachten. Die genaue Bestimmung der den Madura-Fuß und die Aktinomykose hervorrufenden Erreger ist für die Türkei noch durchzuführen.

Von weiteren selteneren Pilzerkrankungen sei noch die Aspergillose erwähnt. HODORA & H. BEHÇET veröffentlichten 1924 einen Bericht über einen Fall einer Hautaspergillose, bei dem *Aspergillus fumigatus* FRESENIUS als Erreger festgestellt wurde. Einen schweren Fall von Lungenaspergillose, der auch zur Sektion kam, beobachtete in Istanbul B. TURHAN, zwei weitere Fälle IÇGÖREN.

In dem vorstehenden Bericht dürfte die türkische mykologische Literatur wohl in ihrer Gänze erfasst worden sein. Abgesehen von allgemeinen Lehrbüchern der Dermatologie für die Studierenden, in denen die Pilzerkrankungen mit abgehandelt werden, bestehen einige mehr monographische Darstellungen der Mykologie von AKÜN, ÜNAL & UNAT, auf die im Schrifttumsverzeichnis hingewiesen wird.

Zusammenfassung

Die Verfasser versuchen an Hand eigener Untersuchungen und anderer im türkischen Raum durchgeführten Untersuchungen einen Überblick über die hier vorkommenden Pilzerkrankungen und ihre Erreger zu gewinnen.

Im Gegensatz zu älteren Untersuchungen wird ein Vordringen der Epidermophytien, besonders der Epidermophytia palmaris et plantaris auch bei der Landbevölkerung festgestellt und die Gründe dafür werden dargelegt. Der Häufigkeit nach konnten folgende Pilzstämme als Erreger der Epidermophytien festgestellt werden: *Epidermophyton floccosum* (HARZ) LANGERON et MILOCHEVITCH, *Epidermophyton interdigitale* PRIESTLEY und *Trichophyton rubrum* (CASTELLANI) SABOURAUD.

Bei den Kopfpilzerkrankungen wurde als hauptsächlichster Erreger der Trichophytia superficialis et profunda capillitii das *Trichophyton violaceum* BLOCH gefunden. Der Erreger des Favus in unserem Krankenmaterial ist das *Trichophyton Schönleini.* Die Mikrosporie tritt an Häufigkeit gegenüber den vorgenannten Kopfpilzerkrankungen zurück, im Ankaraner Material wurde als Erreger nur das *Microsporon canis* BODIN gefunden. Bei der Trichophytie des übrigen Körpers und der Barttrichophytie steht als Erreger ebenfalls das *Trichophyton violaceum* BLOCH an der Spitze. Bei Onychomykosen sind die häufigsten Erreger das *Epidermophyton floccosum* (HARZ) LANGERON et MILOCHEVITCH und das *Trichophyton interdigitale* PRIESTLEY, andere Erreger treten an Häufigkeit diesen gegenüber zurück.

Von saprophytären Pilzerkrankungen kommt die Pityriasis versicolor häufiger vor, Erythrasma und Piedra sind sehr selten.

Es wird ferner über vereinzelte Fälle von oberflächlichen und tiefen Blastomykosen berichtet, bei denen als Erreger die *Candida albicans* und der *Cryptococcus neoformans* (SANFELICE) VUILLEMIN gefunden wurden.

Von seltenen tiefen Mykosen wurden aus der Türkei vereinzelte Fälle von Histoplasmose (*Histoplasma capsulatum*), Sporotrichose (*Sporotrichum Schenckii*),Rhinosporidiosis (*Rhinosporidium Seeberi*), Madura-Fuß und Aktinomykose sowie Aspergillose (*Aspergillus fumigatus* FRESENIUS) mitgeteilt.

Summary

The authors undertook the task, on hand of their own investigations and by reviewing the Turkisch literature, to give a picture about the occurrence of fungus diseases and their causative agents.

In contradistinction with older investigations an increase of Epidermophytia, particularly, that of the palms and the soles, have been noted also in the rural population and their reasons are discus-

sed. According to their frequency the following fungus species as causative agent of Epidermophytia were established(*E. floccosum* (Harz) Langeron et Milochevitch, *E. interdigitale* Priestley and *Tr. rubrum* (Castellani) Sabouraud.

In tinea capitis (superficialis et profunda) as the main causative species *Tr. violaceum* Bloch was established. In favus only *Tr. Schönleini* was found. Tinea microsporina, in comparison, is far less in the material at Ankara, with the only causative agent of *M. caninum* Bodin. In cases of trichophytia corporis et barbae the prevalent agent was also the *Tr. violaceum.* In onychomycosis *E. floccosum* and *Tr. interdigitale* were prevailing.

Among the saprophytosis Pityriasis versicolor was more frequent, while Erythrasma and Piedra were extremely rare.

The review also refers to superficial and deep seated blastomycoses in which *C. albicans* and *Cryptococcus neoformans* (Sanfelice) Vuillemin, respectively, were found.

Among rare mycoses there were found in the Turkey scattered cases of histoplasmosis (*H. capsulatum*), sporotrichosis (*Sp. schenckii*), rhinosporidiosis (*Rhinosporidium seeberi*), madura foot, actinomycosis as well as aspergillosis (*A. fumigatus* Fres.).

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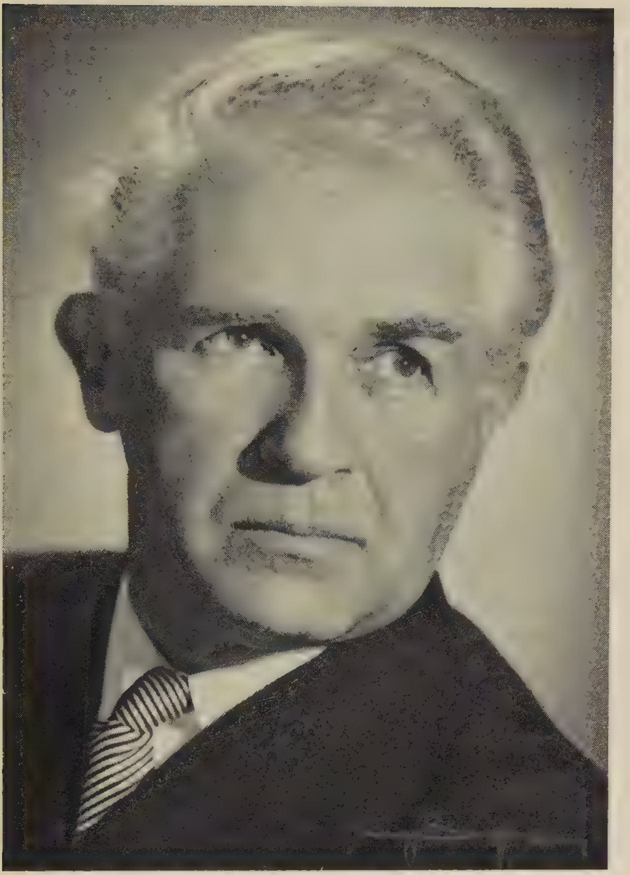

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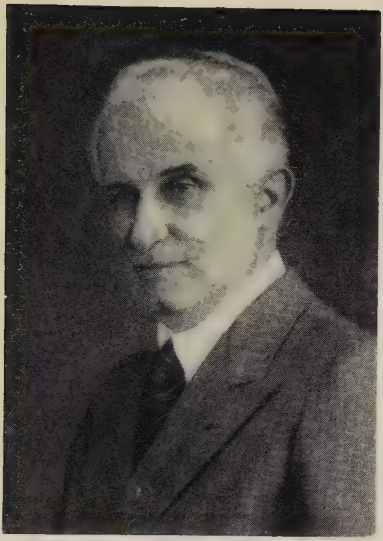

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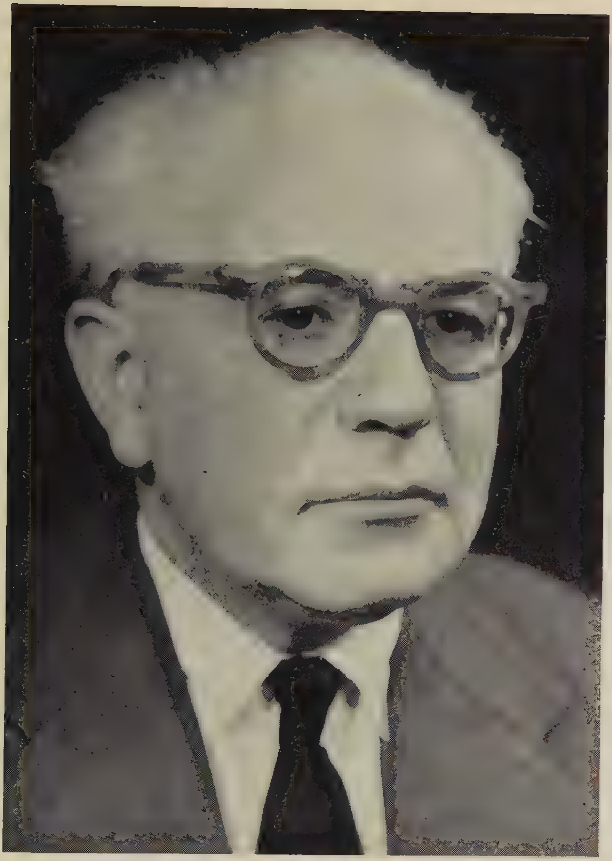

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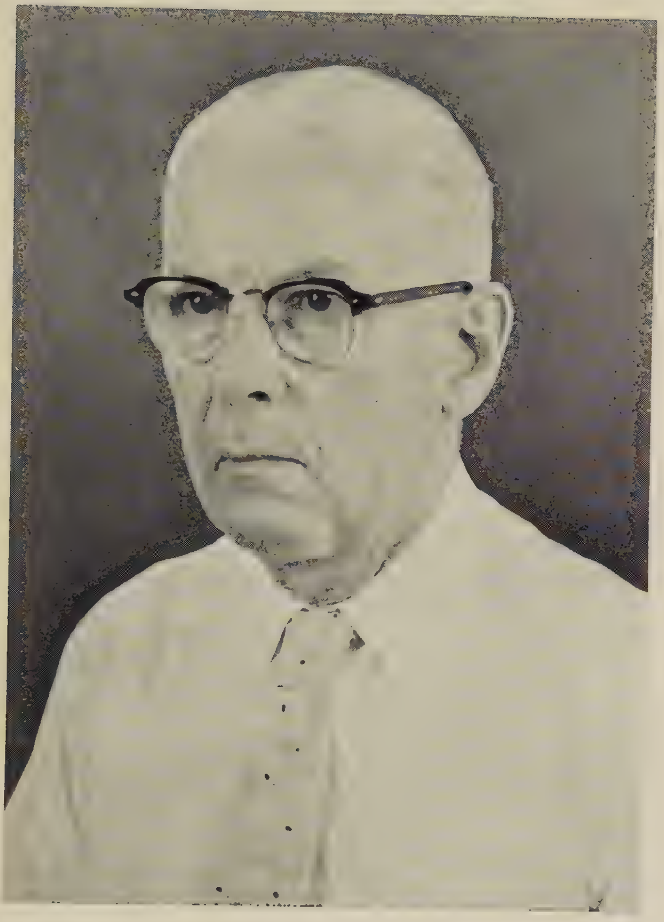

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LARGE FORMS OF HISTOPLASMA

by

C. J. K. Wang, J. Schwarz & G. L. Baum[1]

(5.VIII.1958)

Large forms of *Histoplasma capsulatum* have been seen in old cultures (9) and in human (necrotic) tissue (1, 4, 8, 26, 32) and in tissue explants from human tissue and from experimentally injected mice (23).

Large forms of *Histoplasma* have been observed from Africa as early as 1943 (16). Several subsequent cases had similar appearance with large ovoid cells of 12 μ or more in greatest diameter. These large cells had relatively thick walls, were often within giant cells, and came from human cases of slow development and benign course (2, 5, 6, 12, 14, 19, 20, 21, 25, 27, 28, 30, 31). Recently spontaneous disease with this organism was reported in African baboons (7, 22). In 1952 and 1953 Dubois et al. presented a similar human case (12, 14, 15) infected in the Belgian Congo and Vanbreuseghem described the causative organism as a new species which he named *Histoplasma duboisii*. The skin reactivity to histoplasmin indicates scattered foci of endemicity in Africa (17, 18).

Some of the initial observations of Vanbreuseghem may need revision but rather extensive work with the strain originally isolated by this author from the Belgian Congo taught us that this organism has sufficient characteristics of its own to be differentiated from the classical *Histoplasma capsulatum* as discovered by Darling.

Our strain 44 was obtained from Dr. Ajello who received it from Dr. Vanbreuseghem. Other African strains used in this paper have come to us through Dr. Drouhet and the origin has been specified in previous reports (10, 11).

Little, if any difference can be established in the saprophytic phase between the classical *Histoplasma capsulatum* and the African strains.

However, the yeast phase of strain 44 contains with great regularity large, rather heavy walled cells (3) which exceed in number the large cells which we have described in the yeast phase of numerous "classical" strains (10, 11). In view of the great variation in size and number of the large cells in cultures of "classical" *Histoplasma* we concluded that even the yeast phase of

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strain 44 in vitro would hardly be characteristic enough to be recognized as different entity (10, 11). If however, in addition strain 44 is tested in vivo (13) morphologic findings can be made which we consider rather unique for this African strain (24). DROUHET & SCHWARZ (10) reported that the "large forms" of *Histoplasma capsulatum* found exclusively in hamster tissues were in some aspects indistinguishable from that of *Histoplasma duboisii*. The large forms of *H. capsulatum* varied in diameter from 6—17 μ and were sometimes observed as homogenous blue staining bodies with no definable detail. A laminated "onion skin" structure was also seen, in the center of which was noted a small ovoid to round ,2—5 μ in diameter which occasionally demonstrated budding. The present paper is primarily a study of "*Histoplasma duboisii*" and an attempt to differentiate this organism from *H. capsulatum*.

Materials and Methods

1. The development of the "laminated onion like" large forms described by DROUHET & SCHWARZ (10, 11) was studied in a group of 24 hamsters injected intraperitoneally with the yeast phase of *Histoplasma capsulatum* (strain 19). Two hamsters were sacrificed daily. Liver, spleen, heart, and lungs of each animal were fixed in 10 % formalin for microscopic examination.

2. For comparison of *Histoplasma capsulatum* and "*Histoplasma duboisii*" six groups of animals (10 hamsters and 10 mice per group) were injected intraperitoneally with 6 of the strains listed in Table I. The yeast phase of all strains grown on Kurung's egg medium was suspended in saline for injection. One hamster and one mouse from each group were sacrificed 4 days after injection and subsequently at weekly intervals. Liver, spleen, heart, and lungs of each animal were fixed in 10 % formalin for microscopic observation.

TABLE I

Provenience of Strains Used in this Study

strain	isolation from	locality	continent
5	"soil" water tower	Cincinnati	North America
18	acute lethal human infection	Cincinnati	North America
19	subacute lethal human infection	Cincinnati	North America
44	human localized infection	Belgian Congo	Africa
57	chronic lethal human infection		Africa
77	human infection (case Cherstey)		Africa
78	human infection (case Ross)		Africa

Strain 44 is the original isolate of "*H. duboisii*" by Dr. VANBREUSEGHEM and was obtained from Dr. LIBERO AJELLO, Chamblee, Georgia.

Strain 57 was obtained from Dr. EDOUARD DROUHET (261 IP), Institute Pasteur, Paris.

Strains 77 and 78 from the London School of Hygiene and Tropical Medicine came to us through Dr. CHESTER W. EMMONS (6522 and 6625), National Institutes of Health, Bethesda, Maryland.

3. The growth of large forms in tissue explants was studied. Hamsters infected intraperitoneally with the yeast phase of *Histoplasma capsulatum* and "*H. duboisii*" were sacrificed after 7 days. Livers or spleens of the animals were cut into small pieces with scissors and planted on blood agar plates. The plates were sealed and incubated at 37° C. One fragment of the tissue together with the colony which had developed on top, was removed daily and was fixed in 10 % formalin solution for microscopic study.

Hematoxylin-eosin, Gridley and Grocott stains were used on all sections.

Results

Experiment 1: (Development of "halo" cells after intraperitioneal injection of "American" strain 19). No yeast cells were recognized in the first two days. From the third day on yeast cells were seen, at first they were 4 μ in size with the rapid development of larger cells some of which measured 7.5 × 4.5 μ after eleven days. But the small forms predominated for the duration of the experiment. On the fourth day the first halos appeared surrounding some isolated cells. The halo cells measured 5—7 μ after eleven days. In some instances a clear space was noted between the halo and the cell wall. "Halo cells" stained blue with H—E and no detail was noted within the cells. On the twelfth day, a second concentric halo was observed in some cells.

The size of the halo surrounding the small yeast cells, therefore, increases in proportion to the length of the time of growth in hamster tissues. The same is true in reference to the number of concentric layers formed around the yeast cells.

Experiment 2: "Halo" cells were seen with all strains in hamster tissue but did not occur in mice. The formation of "halo" cells was very similar with every single strain (Table II). For example, in strain 57, a few small yeast cells (measuring 4 μ) appeared with a small halo of 8 μ after two weeks. By the third and fourth weeks many cells had halos which increased to 13 μ. With hematoxylin-eosin stain, some "halo" cells showed a small yeast surrounded by a deeply stained layer. Other cells stained uniformly deep purple. In the fifth week, halo cells measured from 13 μ to 23 μ. These "halo" cells by this time showed several concentric layers with the Gridley stain (and only occasionally with H—E). In the seventh and eighth weeks the "halo" cells frequently were seen separated from the tissue by an empty space.

The yeast cells of all strains were found predominately in the peritoneum of hamsters and mice. Liver and spleen were often invaded. The lungs were found infected in some of the animals which died from the infection.

TABLE II

Size and Number of "Halo Cells" in Hamster Tissues

	Histoplasma capsulatum					*Histoplasma duboisii*
	African strains			American strains		
	S-57	S-77	S-78	S-5	S-18	S-44
4 days to 1 wk.	0	0	0	0	0	0
2 weeks. . .	8 μ	7 μ 1)	11 μ 1)	0	0	7–10 μ 3)
3 weeks. . .	10–13 μ 2)	6–13 μ 3)	11 μ max. 25 μ	0	5–8 μ 1)	7–13 μ 3)
4 weeks. . .	10–13 μ 2)	17 μ 3)	— 1)	8–17 μ 2)	0	8–17 μ 3)
5, 6, 7 wks. .	6–27 μ max. 30 μ 3)	6–21 μ 2)	—	1	1	13–26 μ 3)
8 weeks. . .	13 μ	17 μ 3)	—	1	1	0

0 = no "halo cells" seen
— = no organism seen
1 = animals died spontaneously prior to days noted
1) = few "halo cells"
2) = moderate number of "halo cells"
3) = numerous "halo cells"

The results of this experiment are summarized in Table II and Table III. Table III shows that the size of yeast cells in S-5, S-18, S-57, S-77 was not increased by the duration of incubation period in animals. They measured in most instances from 2 × 5 μ to 4 × 6 μ and were spherical to ovoid throughout the nine weeks of the experiment. Occasionally larger cells (6.5 μ) were seen. Strain 78 had even larger cells (up to 8 μ).

"*Histoplasma duboisii*" in mouse or hamster tissues appeared as spherical or oval yeast-cells of 2—5 μ in the first week. Occasionally, a few larger ones were seen (8.5 μ, Table III). As the incubation period in the animals lengthened, the size of the cells increased. By the fifth week, they measured 13 μ; by the ninth week some of them reached to 17 μ. These large yeast cells were either spherical or oval, with distinct cell walls and cytoplasm which could be easily demonstrated with Gridley or Grocott stains. Sometimes the whole cell was uniformly black with the Grocott stain with the loss of all inner detail. The large yeast cells were present in hamster and mouse tissues.

The "halo" cells were also seen in *H. duboisii* in hamster tissues (Table II). The formation of these "halo" cells was similar to that in *H. capsulatum*, strain 57. In addition, the large yeast cells of *H. duboisii* were sometimes also surrounded by halos.

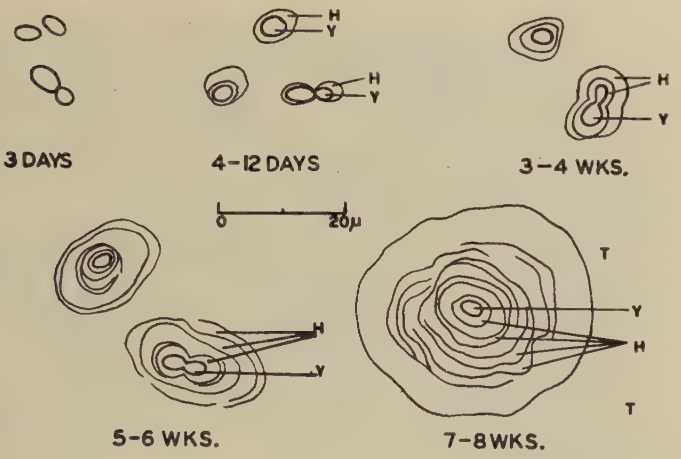
H
Y
H
Y
H
Y
3 DAYS
4–12 DAYS
3–4 WKS.
0
20μ
T
H
Y
Y
H
T
5–6 WKS.
7–8 WKS.

Fig. 1: Development of "halo" cells of *Histoplasma* in hamsters. Camera lucida. Gridley stain. First two drawings from strain 19, others from strain 57. Y = yeast. H = halo. T = hamster tissue.

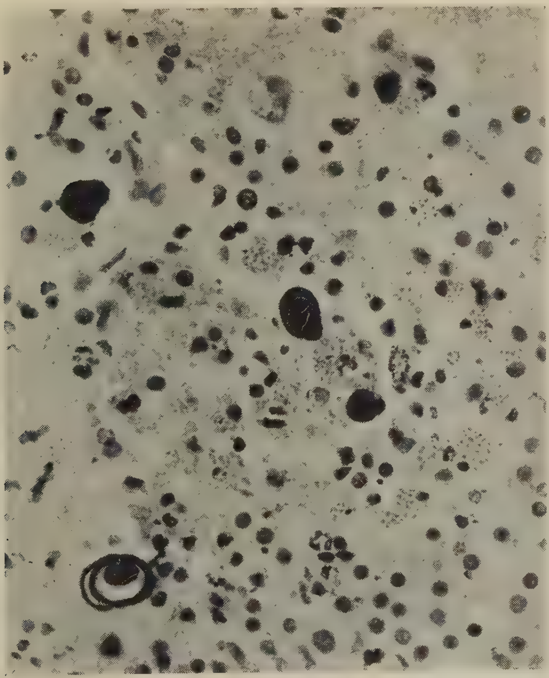

Fig. 2: "Halo" cells of *Histoplasma* with partially or completely obscured central yeast cells. Small "classical" *Histoplasma capsulatum* in swollen histiocytes. Hematoxylin-eosin, strain 18, ×650.

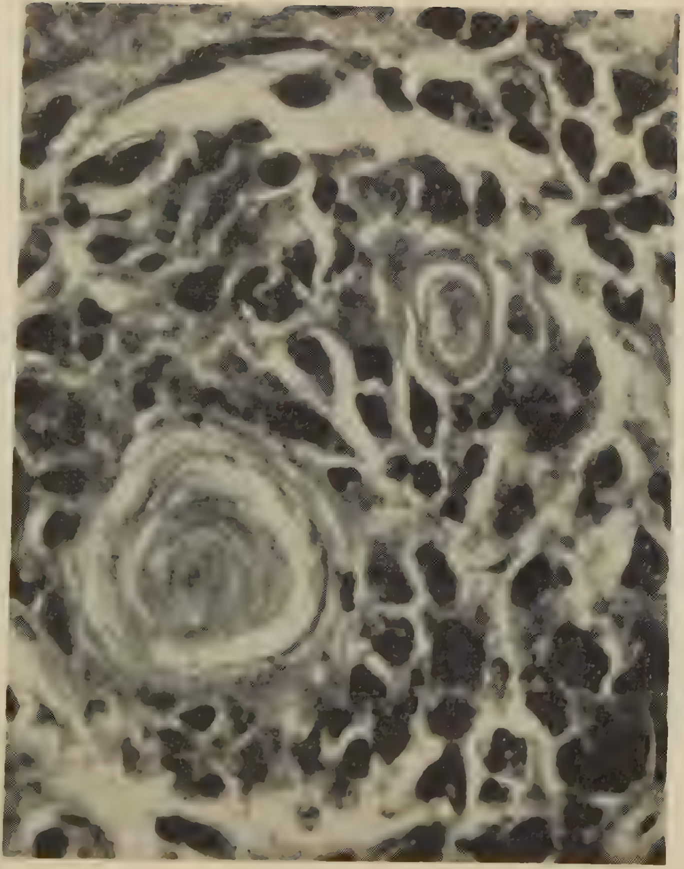

Fig 3 "Hallo" cells of *Histoplasma capsulatum*, strain 57 in hamster tissue. Note the numerous onion-like formations of layers. Hematoxylin-eosin, ×1000.

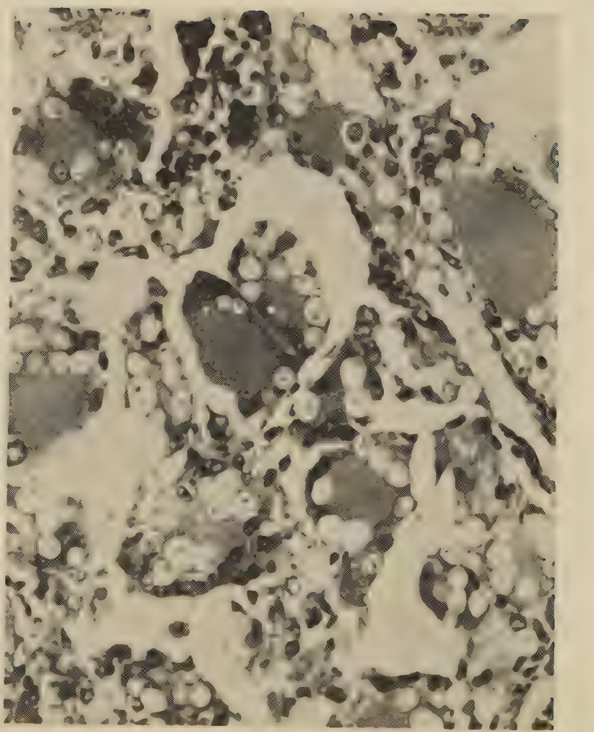

Fig. 4: *H. duboisii* in enormous giant cells in the periotoneum of hamster, 67 days after intraperitoneal injection. Hematoxylin-eosin, ×600.

TABLE III

Comparison of Size and Number of Yeast Cells (without "halo") in 6 strains of Histoplasma in Animal Tissues

Days after inoculation	African strains of Histoplasma capsulatum						American strains of Histoplasma capsulatum				"Histoplasma duboisii"	
	S-57		S-77		S-78		S-5		S-18		S-44	
	Ha	M	Ha	M	Ha	M	Ha	M	Ha	M	Ha	M
4	2–5 s $^{1)}$	2–5 s $^{2)}$	2–6.5 s $^{3)}$	2–6.5 –8 s $^{3)}$	2–5 s $^{1)}$	2–5 s $^{2)}$	2–5 s $^{1)}$	—	2–5 s $^{1)}$	—	—	2–6 s $^{1)}$
7–14	2–5 s $^{3)}$	—	2–6.5 –8 s $^{3)}$	2–6.5 s $^{2)}$	2–6.5 s $^{2)}$	2–5 s $^{2)}$	2–5 s $^{2)}$	2–5 s $^{3)}$	2–5 s $^{2)}$	2–5 s±	2–8	2–8 s $^{1)}$
21–28	2–5 s $^{3)}$	-	2–5 s $^{3)}$	—	2–5 –8 s $^{1)}$	—	2–5 s $^{3)}$	—	2–6.5 s $^{3)}$	2–5 s±	2–10	2–10 l $^{1)}$
35–41	2–5 s $^{1)}$	—	2–5 s $^{2)}$	—	2–6 s $^{1)}$	2–5 s $^{2)}$	*	—	2–5 s $^{3)}$	2–5 s±	4–13 l $^{2)}$ s $^{1)}$	4–13 l $^{2)}$
49–56	2–5 s $^{2)}$	—	2–5 s $^{3)}$	—	2–5 s $^{1)}$	2–5 s $^{1)}$	*	2–5 s $^{1)}$	*	2–5 s±	4–13 l $^{1)}$ s $^{1)}$	6.5–13 l $^{2)}$
63	*	—	*	—	*	—	*	2–5 s $^{1)}$	*	2–5 s±	14-17 l $^{2)}$	11–17 l $^{2)}$

Ha: hamster
M: mouse
s: small yeast cells "classical Histoplasma capsulatum"
l: large yeast cells apparently "exclusive" in H. duboisii
—: no yeast cells found in tissue
*: animals died spontaneously prior to days noted
±: very few yeast cells
$^{1)}$: few yeast cells
$^{2)}$: moderate number of yeast cells
$^{3)}$: numerous yeast cells

Experiment 3: (Tissue explants.) The results of tissue explants of *Histoplasma capsulatum* (Strain 5) in hamsters were similar to that in mouse tissue explants reported previously.

First day. Yeast cells were small, 4 μ or less, in clusters. There was little change observed in hamster tissue.

Second day. Yeast cells in the center portion of the liver were still small, less than 4 μ. However, those at the edges of the liver increased up to 6 μ. Some of these enlarged cells were budding, some produced short protuberances.

Third day. Yeast cells in the center of the liver remained unchanged. Those at the edges of the liver were all 6 μ with few large ones measuring 8.5 μ in diameter. Cell walls were thin, cytoplasm and nuclear material were present. These cells were scattered or in clusters. Some of the protuberances grew longer and became hypha-like. Tissue of the center part of the liver became autolyzed.

Fourth day. Many cells measured from 8.5 μ to 10 μ in diameter. A number of colonies consisting of small and large yeast cells, and hyphae were observed on the surface of the liver.

Fifth day. Yeast cells were larger, some measured up to 13 μ in diameter. The large cells were single, budding, or producing mycelia.

Seventh day. Small yeast cells, less than 4 μ were still present in the center of the liver. Most of the large cells at the outer layer measured 10 μ or more in diameter. The fine inner structure of a number of cells of 10 μ to 14 μ was not discernable, though the buds or hyphae from these empty appearing cells were filled with cytoplasm. With hematoxylin-eosin stain the cell walls of these large cells were much thinner than those of *H. duboisii*. In addition to the above described cells, some cells in the liver were stained deep purple by hematoxylin-eosin stain. With the Gridley stain the latter cells could be distinguished as small yeast cells surrounded by pink halos. These cells were the same as those "halo" cells found exclusively in hamster tissue described above. No hyphae were produced from these "halo" cells.

Ninth through fifteenth day. The general appearance of the yeast cells was similar to that on the seventh day, but more large cells (13 μ) and "halo" cells were seen.

The behavior of strain 44 ("*Histoplasma duboisii*") in hamster tissue explants was similar to that of *Histoplasma capsulatum* under the same conditions.

A hamster, 41 days after the injection of strain 44 was sacrificed. Spleen and peritoneum were cut into pieces and then placed on blood agar plates. Tissue pieces together with the colonies which developed on them were removed at 2, 6, and 9 days and sectioned.

On the day the animal was sacrificed there were many large cells measuring from 8.5 μ to 13 μ in the spleen of the hamster. In the peritoneum numerous small cells and some large ones (10 μ) could be seen. All the large cells had recognizable cytoplasm and distinct walls, some of them had halos (cell — 9 μ, halo — 25 μ).

Second day. Many large spherical or oval cells were found in the spleen (8 μ, 10 μ, 13 μ). It was hard to determine whether those large cells had enlarged directly from the small ones due to the tissue explant environment or due to the characteristics of "*Histoplasma duboisii*". Some of the cells had halos. Numerous small cells were found in the peritoneum.

Sixth day. The general appearance of the organisms was similar to those on the second day.

Ninth day. The appearance of the yeast cells was similar to that of the *Histoplasma capsulatum* cells in liver tissue explants. Diameters of cells were in the range of 8 μ to 10 μ. A few exceptionally large cells were 17 μ in diameter. The cytoplasm of some of the cells was not visible. On the surface of the spleen, colonies consisting of small yeast cells, large yeast cells and hyphae were also present. Some "halo" cells were found scattered in these colonies, however

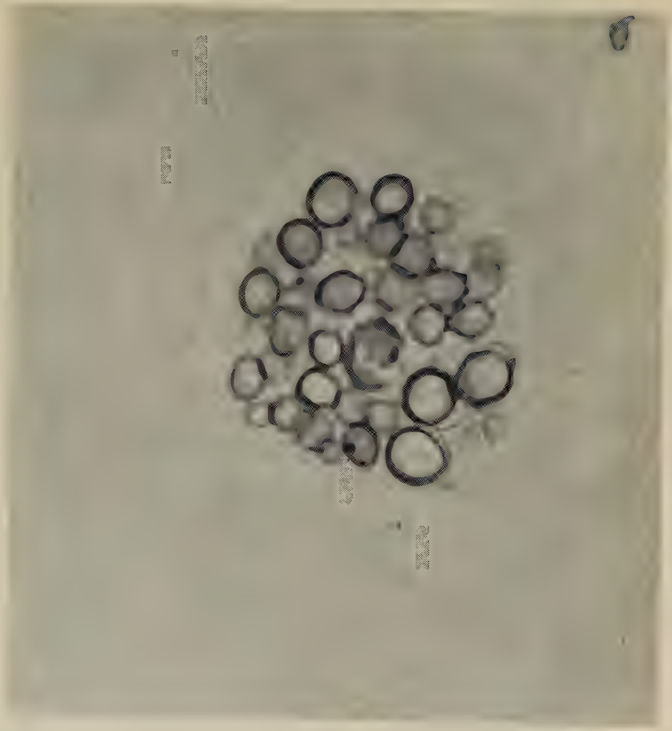

Fig. 5. Yeast cells of *H. duboisii* within giant histiocyte, same hamster. Gridley stain, ×600.

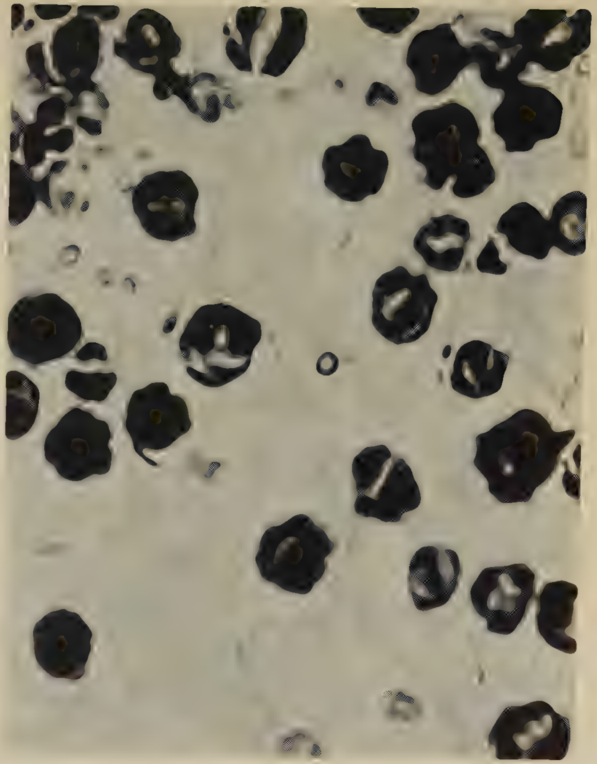

Fig. 6 Small and large forms of *H. duboisii* in the peritoneum of mouse. Note the heavy staining of the large forms. Grocott stain, ×1230.

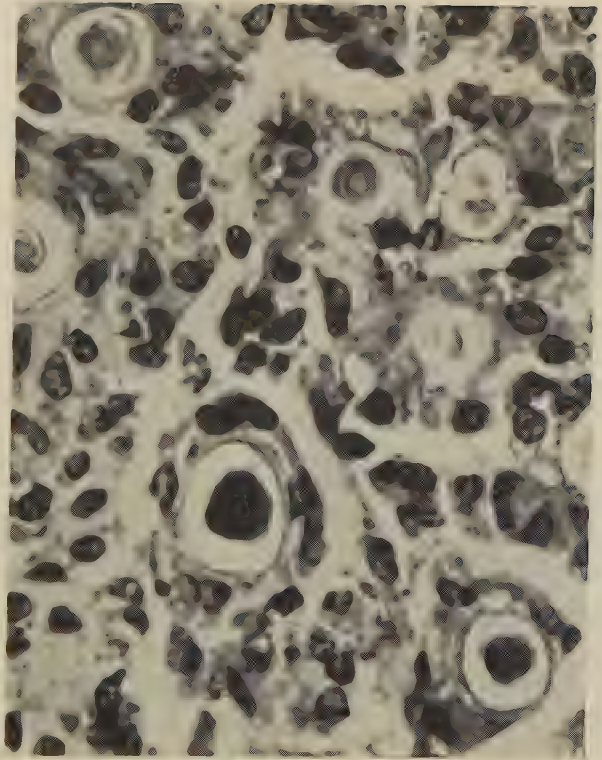

Fig. 7: "Halo" cells of *H. duboisii* in peritoneum of hamster. The halos form around larger yeast cells, than in *Histoplasma capsulatum*. Hematoxylin-eosin, × 1230.

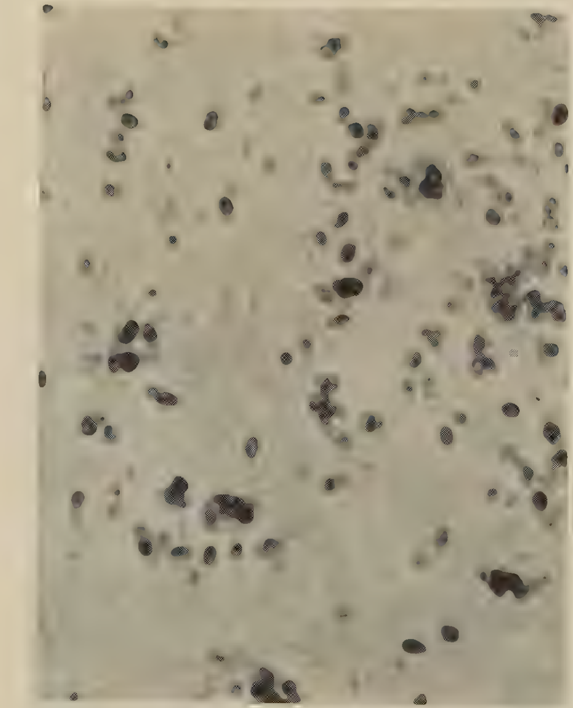

Fig. 8: "Classical" form in histoplasmosis.

Fig. 8, 9, 10: *Histoplasma capsulatum*. Gridley stain, all × 730.

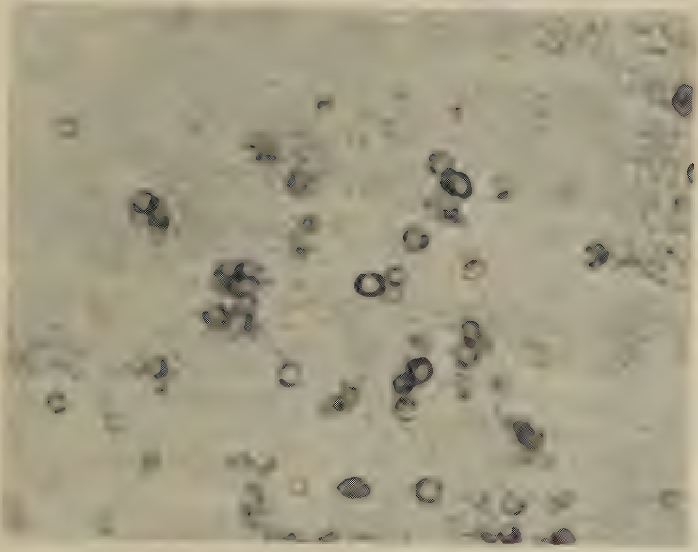

Fig. 9 "Large" forms in caseated adrenal gland.

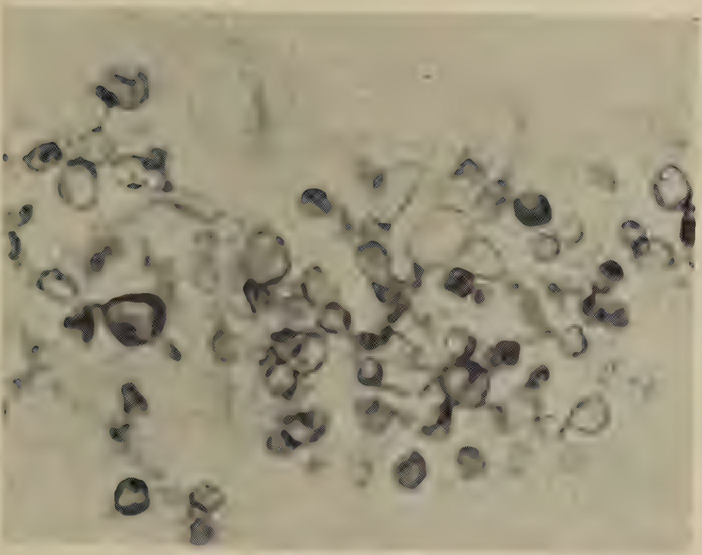

Fig. 10: Large form in explant of hamster tissue.

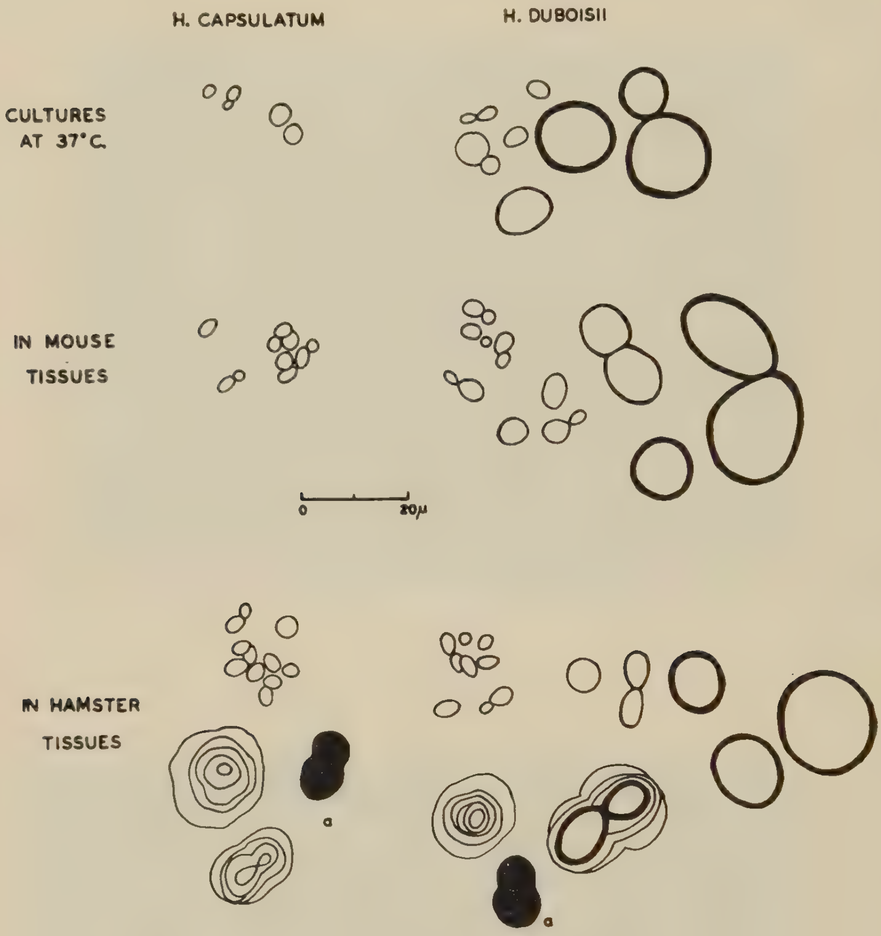
H. CAPSULATUM
H. DUBOISII
CULTURES AT 37°C.
IN MOUSE TISSUES
0
20μ
IN HAMSTER TISSUES
a
a

Fig. 11: Semi-schematic comparison of the appearance of cells in the yeast phase of *H. capsulatum* and *H. duboisii* in culture, in mouse and in hamster tissues. Camera lucida

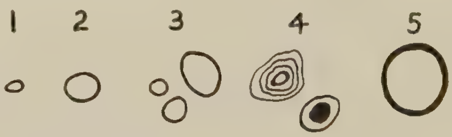

Fig. 12: Diagramatic drawing of 5 forms of *Histoplasma.*

1. "classical" *Histoplasma capsulatum*
2. Large forms of *Histoplasma capsulatum* as observed in necrotic tissue
3. Irregular forms of *Histoplasma capsulatum* in tissue explants
4. "Halo" forms in hamsters seen with *H. capsulatum* and *H. duboisii*
5. Large forms of *Histoplasma duboisii* in culture and tissue.

they did not produce protuberances. The whole picture was indistinguishable from that of *Histoplasma capsulatum.*

Discussion

In hamster tissue halos are found surrounding the small yeast cells, and the large yeast cells of American and African *Histoplasma.* It is believed that the formation of the halo is a reaction between the affected hamster tissue and the yeast cells in general. The halos seemed to be the accumulation of substances produced by the host tissue in response to the presence of the organisms. The number of layers of halos surrounding the cells increased as the "incubation period" in hamsters lengthened. However, the small yeast cells in the center remained unchanged. This phenomenon of halo formation in tissue of the hamster was observed by us also with *Cryptococcus neoformans* and *Blastomyces dermatitidis* which underlines the fact that the hamster provides the "halo" whatever the invading yeast may be. With the Grocott stain, the halos remained colorless whereas the small yeast cells in the center took the stain. With hematoxylin-eosin stain the layers of halos occasionally were distinguishable, but often the whole formation stained uniformly deep blue with no detail seen. The halo of cells which stained deeply blue with H-E contained mostly calcium.¹) No mycelium was ever produced by the halo cells in tissue explants in contrast to the non-halo cells which enlarge and later produce mycelia.

Observations made on tissue explants of livers and spleens of hamsters infected with American and African *Histoplasma* strains were similar to the findings in mouse tissues or necrotic human tissue (23). The enlargement of the yeast cell is probably due to some mechanism which stimulates the increase of the size of yeast cell in non-viable tissues, possibly by inhibiting budding. The observation of large naturally occurring yeast cells in a caseated adrenal gland (26) and in other necrotic human tissues by BINFORD (4) indicates that some of these conditions had been duplicated in tissue explants. The authors agree with BINFORD'S (4) conclusion that these large yeast cells are a phase of *Histoplasma* and not a second fungus. In tissue explants large yeast cells from American *Histoplasma* show thinner cell walls than the naturally occurring large cells of "*H. duboisii*". The results indicate that the nature of the large forms of *H. capsulatum* found in tissue explants or in necrotic tissue is different from the large forms of "*H. duboisii*". The tissue explant experiment also shows that the small yeast cells in the center of the "halo" cell do not enlarge or produce mycelium.

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¹) Dr. B. LANDING made and interpreted the following histo-chemical studies: Von Kossa, direct Schiff, Ac. $KMnO_4$-Ald. Fuchsin, iron stain. He considers calcium a considerable part of the "halo".

This suggests that the halo either inhibits the growth of the small central cells or surrounds only already inactive or dead cells.

The question arises as to whether "*H. duboisii*" is a distinct species or merely a large form of *H. capsulatum*. Their comparisons can be summed up as follows:

1. The mycelial phase of "*H. duboisii*" is indistinguishable from that of *H. capsulatum*. DROUHET & SCHWARZ (10, 11) studied the cultural appearance, growth rate and pigment formation in the mycelial phase of 14 American strains and three African strains of *Histoplasma*. They found variations in each strain. There were differences in the quantitative relationship between tuberculate spores and microspores. However, no definite pattern could be found to separate American from African strains in the saprophytic phase.

2. The yeast phase culture (33 days on Kurung's egg medium) shows that "*H. duboisii*" had many large yeast cells in addition to the small yeast forms. Most of the large cells measure 13 μ and some reach 21 μ diameter. They are spherical or oval, single or budding. They show distinct cell walls and one or more oil globules in the cytoplasma. The yeast phase culture of *H. capsulatum* of the same age (strain 5) has mostly small cells with a few large ones which measure less than 10 μ. According tot DROUHET & SCHWARZ (10, 11), large yeast cells measuring from 6 to 17 μ in size were not restricted to the African strains. From 13 American strains in the yeast phase, two had numerous large forms, three had a moderate amount and only two had none.

3. In hamsters and mice during the first week after intraperitoneal injection of the yeast phase, of *H. capsulatum* and "*H. duboisii*" all cells appear small. The size of the yeast cells of *H. duboisii* increases as the incubation period becomes longer. At the end of nine weeks only few small cells remain. The large cells have reached the size of 13 μ or more. All these large cells have distinct cell walls and cytoplasm. Some cells of *H. capsulatum* also increase in size in animal tissue, however, this is uncommon. In addition, they seldom get larger than 9 μ in diameter.

4. The large forms of *H. capsulatum* and "*H. duboisii*" in hamster tissue described by DROUHET & SCHWARZ (10, 11, 24) are mostly "halo" cells which are not (necessarily) identical with the large form of *H. duboisii* described by VANBREUSEGHEM. However, VANBREUSEGHEM (29) noted that some cells from lymph nodes had thicker capsules which seemed to present stratified layers, like a starch grain. From his description these cells seem to be similar to the "halo" cells found by us in the tissues of hamsters.

5. The large forms of *H. capsulatum* obtained in tissue explants are similar to that observed in necrotic human tissue. They show thinner cell walls than the large cells of "*H. duboisii*".

6. Most strains of *H. capsulatum* are pathogenic to mice and hamsters. "*H. duboisii*" causes no death in mice but produces progressive organ involvement in mice and hamsters and occasional death in hamsters. A comparison of *H. capsulatum* and *H. duboisii* using all criteria studied is presented in Table IV and Figure 11.

TABLE IV

Comparison of American and African (duboisii) histoplasmosis

	Histoplasma capsulatum	*Histoplasma duboisii*
Saprophytic (mycelial) phase	white cottony colony at first; buff to brown with age. Variable numbers of tuberculate spores.	identical
Parasitic (yeast) phase	creamy to warty clear creamy colonies. Cells 2–5 μ first; in older cultures variable numbers of larger cells seldom above 9 μ in size.	gross appearance identical. Cells 2–6 μ first; more and more large cells develop of 10–13 μ or more (up to 21 μ).
Pathogenicity in mice	most strains lethal on massive intraperitoneal injection.	not lethal under the same conditions. (reference 24)
Pathogenicity in hamsters.	most strains lethal on intraperitoneal injection.	seldom lethal even after massive intraperitoneal injection. (reference 24).
Tissue response in mice.	Histiocytic proliferation, necrosis, occasional "tubercle" formation. Exclusively small "classical" yeast cells of 2–5 μ.	Huge tissue giant cells engulfing the large yeast cells (10–22 μ).
Tissue response in the hamster.	as above with occasional to numerous "halo" cells (especially in "African" strains).	Numerous large yeast cells, some with halo, and also "halo" cells with comparatively small central yeast cells. Huge tissue giant cells.
Distribution	World wide	Africa

Conclusion

It is apparent from our study that in the yeast phase *Histoplasma* can be found in 5 distinct forms:

1. The "classical" *Histoplasma capsulatum* form which is slightly ovoid and which measures 2—5 μ in size.

2. The occasional "large" forms to be found in necrotic tissue and old cultures. They measure 6—9 μ, seldom more.

3. The induced giant forms in tissue explants which have sizes up to 20 μ, are round or ovoid and can have relatively thick walls. We believe them to be originating from small yeast cells.

4. The peculiar "halo" cells which have multiple layers, surrounding small "classical" yeast cells, and occasionally the large "*duboisii*" forms, are seen in tissue of hamsters with American and African strains. In certain instances similar onion-layer (= starch grain) structures have been seen with *H. duboisii* in spontaneous human disease.

5. The "*duboisii*" forms which are found in cultures and in experimentally infected animals for about two weeks mixed with small "classical" yeast cells; in older cultures the large forms become more and more numerous, and measure up to 22 μ. The walls can be rather heavy. This type of large form is found exclusively in "*H. duboisii*".

"*H. duboisii*" and *H. capsulatum* are indistinguishable in the mycelial phase, in young cultures of the yeast phase and in animal tissues within two weeks after inoculation. However, in old yeast phase cultures of "*H. duboisii*" a majority of the cells becomes 13 to 22 μ in diameter. In animal tissues when the incubation period lengthens, the yeast cells of "*H. duboisii*" become regularly 13 μ or more. This is one conspicuous characteristic of "*H. duboisii*" and thus it serves as a criterion to differentiate "*H. duboisii*" from *H. capsulatum* morphologically.

Therefore it is possible to separate *Histoplasma duboisii* from the "classical" *Histoplasma capsulatum* by (1) its size in the parasitic phase in vivo and in vitro, by (2) its different pathogenicity for experimental animals, and by (3) the most particular tissue response in hamsters and mice (24).

Too few human and (spontaneous) animal cases have been so far recorded to make conclusions based on clinical behavior.

Summary

Various types of large forms of *Histoplasma* were studied in experimentally infected hamster and mouse tissues. *Histoplasma* can be found in the yeast phase in 5 distinct forms: 1. the classical *Histoplasma capsulatum* form (ovoid, 2—5 μ in size); 2. occasional "large forms" in necrotic tissue and old cultures (up to 9 μ); 3. induced large forms in tissue explants (up to 20 μ); 4. small or large yeast cells surrounded by "halos" (up to 30 μ) and 5. the "*duboisii*" form (up to 22 or more) found exclusively in *Histoplasma duboisii*. Correlations between the above large forms with the classical small form were discussed. *Histoplasma duboisii* and the "classical" *Histoplasma capsulatum* can be separated (1) by its size in the parasitic phase in vivo and in vitro; (2) by its different pathogenicity for experimental animals and (3) by the most particular tissue response in hamsters and in mice.

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LE MICROSPORUM GYPSEUM. QUELQUES OBSERVATIONS CLINIQUES ET MYCOLOGIQUES CONCERNANT CE DERMATOPHYTE.

par

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Jusqu' à ces dernières années le *Microsporum gypseum* était inconnu en Roumanie. Ailleurs on avait réussi à isoler ce parasite des lésions les plus diverses telles que les mycoses folliculaires (à l'aspect de microsporie ou de trichophytie) sèches ou inflammatoires du cuir chevelu ou de la barbe, le favus à godets, les onychomycoses, le herpès circiné. Dans la littérature récente, on trouve de plus en plus fréquemment des observations ayant rapport à des pareilles mycoses dont la source d'infection avait été le sol. On a même réussi, en plusieurs pays, à isoler le *Microsporum gypseum* directement du sol et on se demande, à juste raison, si ce champignon ne mène pas normalement, une partie de son existence comme simple saprophyte du sol.

Nos observations personnelles, au sujet du *Microsporum gypseum*, concernent 4 cas de mycoses dues à ce dermatophyte et l'isolement de celui-ci des diverses couches du sol. Nos observations cliniques sont les suivantes:

1. Homme âgé de 30 ans. Vient nous consulter pour des lésions vésiculeuses de la barbe. Son affection a débuté il y a 3 semaines. Le malade est incapable de préciser exactement la source de l'infection, mais il soupçonne le barbier. Au niveau du menton il présente 3 plaques circulaires, dont le diamètre varie de 1 à 2 cm, légèrement infiltrées, couvertes de petites croûtes et présentant une couronne de vésicules périphériques. Une partie des poils qui traversent les croûtes sont cassés à 2 mm environ de leur émergence folliculaire et parasités par un dermatophyte dont la disposition rappelle celle des microsporums. Om a isolé le *Microsporum gypseum.*

2. Garçon âgé de 7 ans. On nous l'amène pour des lésions squameuses du cuir chevelu. La source de l'infection n'est pas précisée. L'affection est vieille de 2 semaines seulement. Au niveau du cuir chevelu on observe de nombreuses plaques squameuses et croûteuses, à cheveux de couleur grisâtre, invadés par un parasite dont la disposition rappelle celle des mégaspores. On a isolé le *Microsporum gypseum.*

3. Femme âgée de 47 ans. Présente sur la fesse gauche une plaque de herpès circiné typique, à diamètre de 3 cm environ, squameuse et légèrement infiltrée. Cette lésion avait été observée par la malade il y a quelques jours seulement. On a isolé le *Microsporum gypseum.*

4. Cette 4-ème observation nous paraît de beaucoup la plus intéressante. Il s'agissait d'une jeune fille âgée de 8 ans, dont la face dorsale du poignet gauche était occupée par une plaque vésiculeuse et pustuleuse, à diamètre de 4—5 cm, circulaire, nettement infiltrée, dont le début datait de quelques semaines. On remarque la présence de nombreux filaments mycéliens dans les vésicules et on isole le *Microsporum gypseum.* L' affection, traitée par des compresses humides à l'eau faiblement iodée et l'application consécutive d'une pomade à l'acide salycilique et benzoïque, guérit au bout de 3 à 4 semaines.

La mère de la malade nous déclare, qu'il y a 4 mois, sa fille s'est fait une brûlure au dos du poignet gauche et avoue l'avoir pansée avec de la terre prélevée du petit jardin situé à côté de sa maison.

Par la suite, nous avons prélevé une certaine quantité de terre de l'endroit même d'où il avait été prélevé par la mère de la malade et aussi d'un endroit situé à une dizaine de mètres plus loin. Les 2 échantillons de terre ont été répartis chacun dans 5 boîtes de Pétri et, utilisant le procédé de VANBREUSEGHEM (voir plus loin), nous avons réussi très facilement à isoler le *Microsporum gypseum,* au bout de 8—15 jours, de toutes ces boîtes, sans exception.

Dans une série d'expériences, effectuées vers la fin de l'hiver dernier dans le but d'isoler des dermatophytes du sol, nous avons prélevé 20 échantillons de terre dans la cour de l'hôpital Colentina à Bucarest. Ces échantillons avaient été prélevés de diverses profondeurs (jusqu'à un mètre). On a réussi à isoler le *Microsporum gypseum* d'un seul échantillon obtenu d'une profondeur de 30—40 cm.

En résumant les données ci-dessus, on peut dire que nous avons trouvé le *Microsporum gypseum* chez 2 malades dans des lésions non folliculaires de la peau, chez 2 autres dans des lésions folliculaires et ayant envahi les poils de la barbe ou les cheveux et, encore, dans les couches superficielles du sol, en des endroits totalement différents.

L'aspect microscopique des poils et des cheveux parasités était variable. Chez le premier malade, les poils paraissaient être invadés par un *microsporum* (fig. 1), avec la seule différence qu' on pouvait distinguer ici, par places, la disposition en chapelets des spores extérieures. Chez le second malade, l'aspect des cheveux était plutôt celui des cheveux envahis par un mégaspore, vues les grandes dimensions des spores (fig. 2). Contrairement aux poils et aux cheveux microsporiques communs, ces poils et cheveux ne

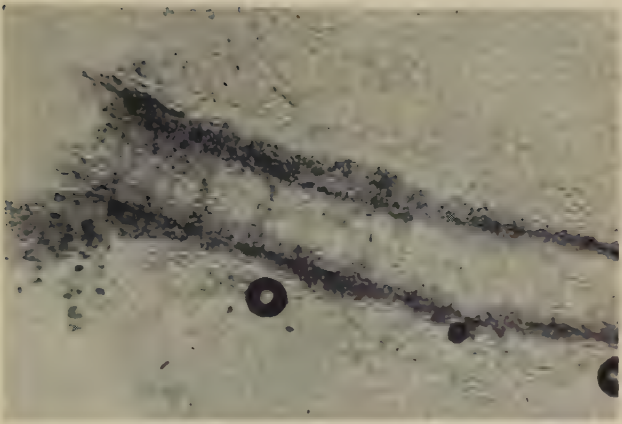

Fig. 1. Poil humain (de la barbe) envahi par le *Microsporum gypseum*. (type microsporique)

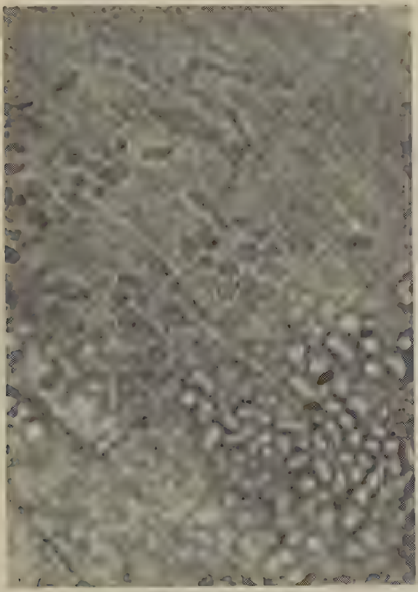

Fig. 2. Cheveu d'enfant envahi par le *Microsporum gypseum*. (type mégasporique)

présentaient pas, à la lumière ultraviolette filtrée de Wood, le phénomène de la luminescence.

Cultivées sur le milieux d'épreuve de Sabouraud, les souches isolées par nous se développaient rapidement. Au bout de quelques jours l'aspect des cultures devenait caractéristique. Elles étaient plâtreuses (fig. 3), de couleur ,,caffé-au lait'' ou chamois, ou orangée, parfois cérébriformes (fig. 4).

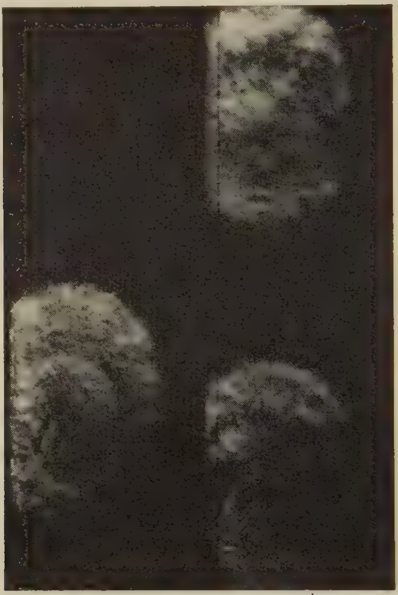

Fig. 3. *Microsporum gypseum*. Culture de 10 jours sur milieu d'épreuve de Sabouraud. (à gauche: souche isolée d'une lésion humaine; à droite: souche isolée du sol)

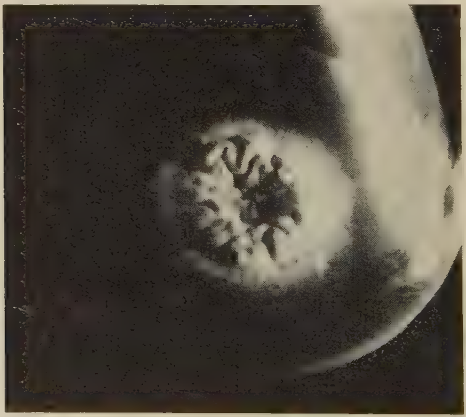

Fig. 4. *Microsporum gypseum*. Culture de 20 jours en matras d'Erlenmeyer. (Aspect cérébriforme)

La morphologie microscopique des cultures développées en chambre humide (goutte pendante en chambre humide de Van Tieghem) était très riche. On voyait des mycéliums en raquette, de nombreuses micro- et surtout macroconidies (dont l'apparition était très précoce) (fig. 5), ces dernières jusqu'à 6 sur un même hyphe ou en chapelet, chacune pluriseptée ayant 5–8 loges (fig. 6). On y voyait aussi d'assez nombreuses vrilles. Fait digne à être signalé, on y trouvait sur un même hyphe, à côté des microconidies et des macroconidies, des spores ovalaires de dimensions variables.

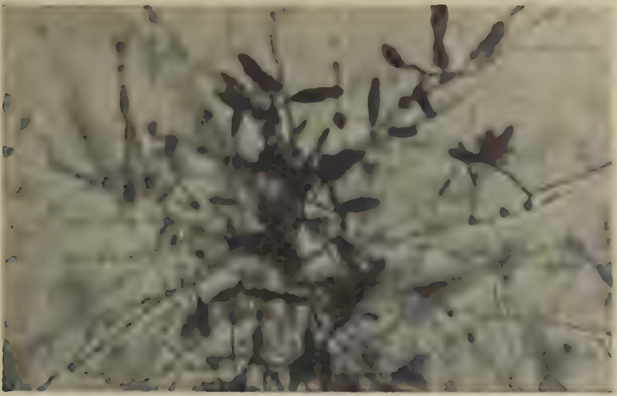

Fig. 5. *Microsporum gypseum*. Microculture de 10 jours. Fuseaux multiples, plusieurs sur un même hyphe.

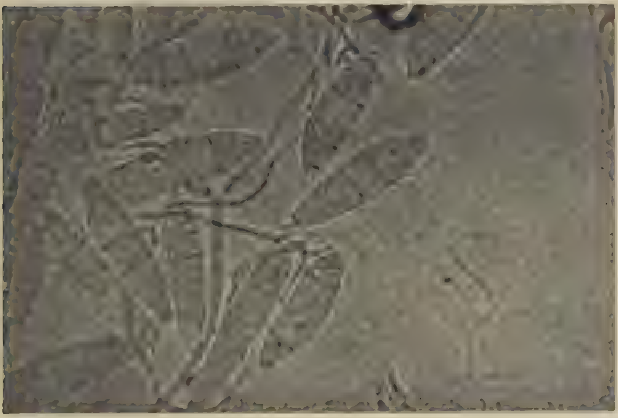

Fig. 6. Fuseaux pluriseptés de *Microsporum gypseum*. Microculture de 10 jour (grossissement: 700 fois)

plus grandes que les premières et plus petites que les dernières, pas ou très peu septées (fig. 7). À notre avis, on peut considérer ces spores comme des véritables formes intermédiaires entre les micro- et les macroconidies.

Ajoutons que toute cette riche morphologie microscopique, y compris les vrilles, s'est développée sur le milieu d'épreuve habituel de Sabouraud. Des ensemencements sur des grains d'orge, sur du crottin de cheval ou sur d'autres milieux spéciaux n'ont pas été nécessaires.

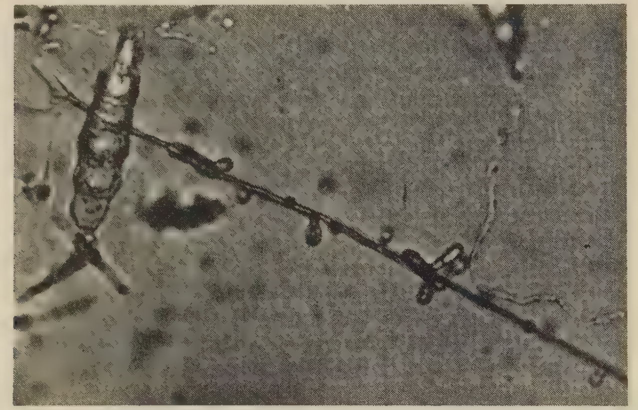

Fig. 7. Aleuries disposées en acladium et "formes intermédiaires". Microculture de 15 jours.

Le procédé, que nous avons utilisé dans le but d'isoler le *Microsporum gypseum* des couches superficielles du sol, est celui préconisé par R. VANBREUSEGHEM. Dans des boîtes de Pétri, au-dessus d'une couche de terre de quelques millimètres d'épaisseur, nous avons déposé des cheveux ou de la laine. Au bout de 8 à 15 jours, les cheveux étaient partiellement envahis par des moisissures diverses et devenaient très fragiles, se rompant au moindre contact. Parmi les divers champignons kératinophyles ayant envahi et détruit les cheveux, on pouvait facilement reconnaître le *Microsporum gypseum*, d'après ses macroconidies caractéristiques et l'isoler sur les milieux habituels.

La similitude des cultures obtenues par l'ensemencement des cheveux et des squames parasitées, récoltées de nos 4 malades et des cultures du parasite isolé des couches du sol ayant contaminé notre 4-ème malade, était parfaite. Par contre, la culture de l'échantillon isolé du sol, dans la cour de l'hôpital Colentina, était plus duveteuse et paraissant être un peu plus vivace. Ces caractères particuliers cessaient d'être visibles dans les cultures vieilles de 3 à 4 semaines. D'ailleurs, la morphologie microscopique était la même.

Les inoculations expérimentales à l'homme, au cobaye et à la souris blanche ont toutes très bien réussi. Les souches isolées des malades, aussi bien que les 2 souches isolées du sol, se sont montrées également pathogènes. Chez l'homme, au point inoculé (face antérieure de l'avant-bras) s'est développé un herpès circiné typique (fig. 8) à caractères nettement inflammatoires. Chez l'animal on a observé en plus l'invasion des poils qui n'étaient pas luminescents à la lumière de Wood. Les rétrocultures, obtenues des hommes et des animaux, ont reproduit exactement les souches qui avaient été inoculées. Ajoutons que ni chez l'homme, ni chez l'animal, les inoculations expérimentales n'ont pas provoqué l'apparition des godets typiques, mais seulement des godets rudimentaires.

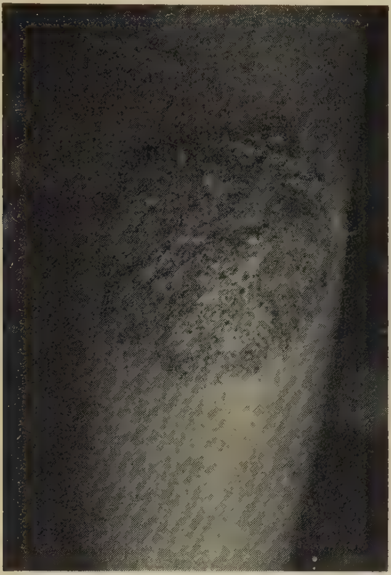

Fig. 8. Mycose expérimentale humaine (herpès circiné de l'avant-bras) à *Microsporum gypseum*. (Souche isolée du sol).

Discussions

D'après Conant et collaborateurs, on a désigné le *Microsporum gypseum* par les dénominations suivantes, qu'on doit considérer synonymes: *Achorion gypseum* Bodin 1907; *Microsporum fulvum* (Uriburu 1907) — Sabouraud 1910; *Microsporum flavescens* Horta 1911; *Microsporum scorteum* Priestley 1914; *Microsporum xanthodes* W. Fischer 1918; *Sabouraudites gypseus* Ota & Langeron 1923; *Gymnoascus gypseus* Nannizzi 1927; *Microsporum gypseum* Guiart & Grigoraki 1928.

Du point de vue botanique, le *Microsporum gypseum* est assez voisin au *Microsporum lanosum*. Sa morphologie microscopique nous a paru plus riche que celle de ce dernier (l'apparition des fuseaux, en grand nombre, était très précoce et les vrilles se développaient sur les milieux habituels). (fig. 9).

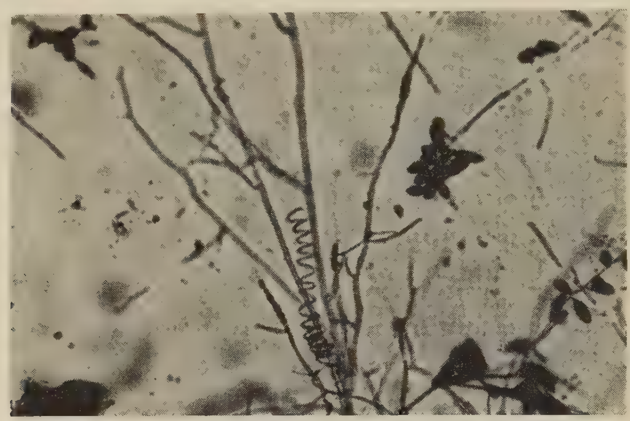

Fig. 9. Vrille. Microculture de 15 jours.

Par sa capacité de provoquer l'apparition des godets, ce parasite a été considéré comme apparenté au champignon du favus, d'où la dénomination d'*Achorion gypseum*. D'autre part, si l'on tient compte de la grande variété des lésions d'où il a été isolé, il paraît difficile de lui trouver une place dans les classifications actuelles des dermatophytes. En réalité, cette espèce a été isolée des lésions suivantes: favus à godets du cuir chevelu ou de la peau glabre (BODIN, ARIEVITCH); kérion de Celse du cuir chevelu (DODGE, ARIEVITCH, CONANT et collab., TALICE); onychomycoses (ARIEVITCH), herpès circiné. Puisque l'aspect des cheveux envahis est parfois celui des cheveux microsporiques, on considère souvent ce champignon comme appartenant au genre *Microsporum*. L'invisibilité, à la lumière de Wood, des cheveux ou des poils parasités ne saurait être invoquée comme preuve décisive contre cette manière de voir, la luimnescence des cheveux envahis par les autres espèces appartenant au genre *Microsporum* n'étant pas, elle même, absolument constante (BEARE & WALKER).

Les réservoirs des mycoses à *Microsporum gypseum* et le problème de l'origine saprophytique de ce parasite.

On n'est pas encore fixé sur le hôte principal de ce dermatophyte, autrement dit, sur l'animal qui l'héberge habituellement. D'après A. M. ARIEVITCH, on a cité des mycoses humaines à *Microsporum gypseum*, qui ont fait leur apparition après un contact avec des chevaux, des chats, des souris ou même des oiseaux. Tout de même excepté quelques pays comme la Géorgie (Etats Unis d'Amérique) où, d'après W. SMITH et collab., le *Microsporum gypseum* est, à côté du *Trichophyton mentagrophytes*, le dermatophyte le plus répandu, partout ailleurs, chez l'homme et chez l'animal, les mycoses dues à cette espèce paraîssent être assez rares.

D'autre part on constate que ce dermatophyte est bien répandu dans la nature puisque, jusqu'à présent, on l'avait isolé des couches superficielles du sol, en Amérique, en Australie et, au moins indirectement en Europe, c'est à dire un peu partout sur la terre. En 1953, sur 116 échantillons de terre, récoltés de Tennesee et de Georgie (Etats Unis), L. AJELLO a réussi à isoler 37 souches de *Microsporum gypseum*. Ce dermatophyte a été trouvé dans le sol aussi par EMMONS (1951), GORDON (1953), DURIE & FREY (1955), FUENTES, BOSCH & BOUDET (en la Havane 1955) et récemment (1957) par W. KAPLAN. HRUSZEK (cité par ARIEVITCH) et, plus tard, H. LANGER ont vu se développer des mycoses humaines à *Microsporum gypseum* à la suite des érosions accidentelles souillées par de la terre.

Donc, il nous paraît bien juste d'admettre, avec VANBREUSEGHEM, AJELLO et d'autres auteurs, que ce dermatophyte est plutôt un simple saprophyte du sol, qu'il se trouve à présent en pleine période d'adaptation à la vie parasitaire et qu'il mène encore une grande partie de son existence comme saprophyte du sol.

Les résultats des recherches récentes de BERND ETTIG, concernant la présence dans les couches superficielle du sol de nombreux microbes (bactéries et actinomycètes) capables d'entraver dans le milieux de culture artificiels le développement des dermatophytes et surtout celui du *Microsporum gypseum*, ne doivent pas être interprétés comme preuve contre cette manière de voir. D'abord, d'après l'avis même de l'auteur, l'action antagoniste de ces microbes a pu être démontrée seulement en ce qui concerne les dermatophytes cultivés sur les milieux artificiels. Dans le sol les conditions peuvent être bien différentes. D'autre part, l'auteur mentionné ne nous dit pas avoir trouvé ces microbes antagonistes dans des échantillons de terre contenant des dermatophytes. On peut donc supposer que ces microbes ne sont pas universellement répandus dans le sol et, par conséquent, ne peuvent pas entraver partout le développement des dermatophytes.

Il va sans dire que le *Microsporum gypseum* n'est pas le seul dermatophyte qui a été isolé du sol. En 1940, S. SZATHMARY annonce avoir isolé de la vase se trouvant au fond de certaines rivières, une variété de l'*Epidermophyton interdigitale* qu'il nomme *Trichophyton fluviale*". Le *Trichophyton mentagrophytes* a été isolé du sol par LURIE & BOROK en 1955. La présence, dans le sol, de l'*Achorion quinckeanum*, paraît aussi, d'après VANBREUSEGHEM, très probable. Mais aucun des dermatophytes, autres que le *Microsporum gypseum*, isolés du sol, n'y est pas si universellement répandu comme l'est ce dernier. Bien plus, on peut supposer que ces dermatophytes ont été déposés dans le sol par des hommes ou des animaux malades, éventualité bien moins probable pour le *Microsporum gypseum*, vue son ubiquité. D'après nos observations personnelles, la présence de cette espèce dans les couches superficielles du sol ne peut pas être toujours expliqée par une contamination accidentelle due à des animaux malades (rats). La petite malade, qui fait l'objet de notre 4-ème observation, a été contaminée par de la terre et nous avons constaté la présence du dermatophyte, dans cette même terre, 4 mois plus tard. Le parasite qui avait persisté là s'y trouvait en grande quantité, puisque nous l'avons très facilement isolé de tous les échantillons de terre récoltés, La mère de la malade niait la présence des rats dans le jardin d'où l'on avait pris cette terre. D'après ce qu'il paraît, le *Microsporum gypseum* menait là une existence saprophytique.

Mais il y a encore d'autres faits qui plaident en faveur de l'origine saprophytique de ce champignon. On admet aujourd'hui que tous les champignons parasites, les dermatophytes y compris, proviennent des champignons saprophytes qui se sont adaptés à la vie parasitaire, en même temps que leur morphologie microscopique devenait de moins en moins riche. Or la morphologie du *Microsporum gypseum* est très riche. On y trouve tous les organes du *Ctenomyces mentagrophytes*, que l'on considère, parmi les dermatophytes, morphologiquement le plus riche et, par conséquent, le plus apparenté au saprophytes primitifs qui se sont adaptés à la vie parasitaire. Mais, d'après notre avis, à ce point de vue, ce dernier champignon doit cédér la place au *Microsporum gypseum* qui possède une variété de spores encore plus grande que celui-ci.

Le *Microsporum gypseum* est peut-être le seul dermatophyte dont on ne connaît pas un hôte auquel il se soit spécialement adapté. Cela veut dire que ce dermatophyte est un saprophyte qui se trouve encore en voie d'adaptation à la vie parasitaire. La grande variété des lésions provoquées par ce dermatophyte, la multitude des formes d'invasion des cheveux plaident dans le même sens.

Notons aussi que ce champignon peut mener, assez longtemps, sur la peau humaine, une existence saprophytique, avant de devenir pathogène. C'était, en effect, le cas de notre 4-ème malade, chez laquelle la mycose s'est développée seulement après 4 mois à partir du moment de son inoculation.

Si l'origine saprophytique de certains dermatophytes, parmi lesquels le *Microsporum gypseum* doit occuper la première place, va se confirmer, alors on pourra élaborer une classification plus logique de ces champignons, basée sur leur phylogénèse. Dans cette classification, les types principaux seront les types primitifs, pas encore complètement adaptés à la vie parasitaire.

Résumé

Les auteurs exposent leurs observations concernant 4 cas de

mycoses à *Microsporum gypseum* dont 2 folliculaires et 2 non folliculaires, de même que leurs observations concernant la présence de cette espèce dans les couches superficielles du sol. Un des cas mentionnés se rapporte à une fillette âgée de 8 ans, chez laquelle la mycose (herpès circiné du poignet) s'est développée à la suite d'une contamination par de la terre. On a réussi à isoler de cette même terre, le *Microsporum gypseum*, 4 mois après le contact infectant, et aussi à l'isoler des couches superficielles du sol, d'un endroit tout différent.

Les inoculations à l'homme, à la souris blanche et au cobaye, des souches provenant des personnes malades, ainsi que des souches provenant des couches superficielles du sol, ont toutes très bien réussi.

La morphologie microscopique des souches isolées des malades et de celles isolées du sol, était très riche. Il y avait d'assez nombreuses vrilles (que l'on pouvait voir sur les milieux usuels), des microconidies (aleuries), de fort nombreuses macroconidies (fuseaux) dont l'apparition était très précoce, et aussi des formes intermédiaires entre ces 2 variétés de spores.

Outre la riche morphologie microscopique, les auteurs relèvent la large distribution du *Microsporum gypseum* dans les couches superficielles du sol et la grande variété des lésions que ce parasite est capable de provoquer.

Appuyés sur ces faits, ils concluent que ce champignon est un saprophyte en voie d'adaptation à la vie parasitaire, saprophyte qui ne s'est pas encore fixé à un animal hôte bien déterminé.

Summary

Microsporum gypseum was unknown in Roumania up to now. The authors report the clinical observations of 4 cases of fungus infections caused by this dermatophyte. In two cases this species produced lesions in the beard and on the scalp; in the two other on the glabrous skin. The most interesting case was that of a girl — 8 years old — who had a herpes circinatus on the hand, due to the contamination with the soil. Four months later, the authors were able to isolate abundantly, from that same soil, *Microsporum gypseum.*

On the other hand, this species has also been isolated from the soil by the authors, almost in the same time, in a quite different place in Bucharest. From the description of the microscopical aspect of the colonies, furnished by the authors, it seems to be interesting the observation of some cells considered as real intermediate forms between aleuro — and closterospores.

The inoculations into man, white mice and guinea pigs with the strains isolated from the human lesions and from the soil, were positive in both cases.

The large spreading of *Microsporum gypseum* in the soil, the

rich microscopical features of the colonies and the great diversity of the lesions it produces, make the authors to conclude that this fungus is a saprophyte of the soil, on the way to be adapted to parasitic life. Sometimes, this species may live as saprophyte, on the human skin (as the authors observed).

It seems also that *Microsporum gypseum* is the only dermatophyte which has not a strict special animal host.

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P.S. En continuant nos recherches pendant que le travail ci-dessus était déjà sous presse, nous avons isolé le *Microsporum gypseum* de 4 autres malades qui présentaient des lésions telles que herpès circinné (2 malades), kérion de Celse (un malade), dysidrose plantaire (une malade). Chez 3 de ces malades l'origine tellurique de la mycose a pu être démontrée. À Bucarest, ainsi qu'aux environs, partout où nous l'avons cherché, nous avons, en fin de compte, reussi à isoler ce champignon des couches superficielles du sol (au total de 9 endroits eloignes l'un de l'autre).

STUDIES ON CRYPTOCOCCUS NIGRICANS, II. THE EFFECTS OF PHYSICAL, CHEMICAL AND NUTRITIONAL FACTORS[1]

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(25.VIII.1958)

The identification and characterization of *Cryptococcus nigricans*, a new species, has recently been described (Rich & Stern, 1958). This report deals with the effect of various nutritional and physical factors on the growth of this organism.

To facilitate interpretation of nutritional and metabolic studies, a minimal, chemically defined medium for the cultivation of *Cryptococcus nigricans* was necessary. The development of this medium will also be discussed.

Experimental Methods and Results

Stock cultures were maintained on slants of Sabouraud-dextrose agar (Difco) and incubated at 28° C. Cultivation in liquid media was carried out in 125 ml Ehrlenmeyer flasks containing 50 ml of medium. Flasks were inoculated with 0.1 ml of a thrice washed, turbidimetrically standardized, distilled water suspension of *Cryptococcus nigricans*. Incubation, unless otherwise specified, was carried out in a temperature controlled, New Brunswick Rotary Shaker (176 cycles min), at 28° C for 7 days. Growth, measured as turbidity, was determined on a Spectronic 20, colorimeter (transmitting at 425 mμ). Values for uninoculated controls were subtracted from the experimental values. Growth units, indicated in the tables, represent the per cent transmission subtracted from 100. All experiments were run in duplicate or triplicate and were repeated at least once. Reported values are expressed as the arithmetic mean, deviation about the mean never exceeding 10 %.

Temperature. Agar slants containing 2 % glucose and 0.5 % yeast extract (Difco) were inoculated with a standardized suspension of *Cryptococcus nigricans* and inoculated at the appropriate temperature for 7 days. The temperature tested, extended from 15° to 35° at intervals of 2 degrees. The optimum temperature was found

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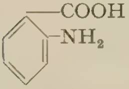
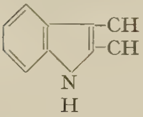
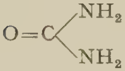
to be 29° C with growth limits at 23° and 34° C. Subsequent to the development of the defined medium, the experiment was repeated in liquid shake cultures. Identical values for the limiting and optimum temperatures were obtained.

Development of Chemically Defined, Minimal Medium. Since a medium containing 2 % glucose and 0.5 % yeast extract (Difco), adequately supported growth of the organism, this was used as a basis for the development of the chemically defined medium. Reducing the concentration of yeast extract to 0.1 %, various nitrogen sources were individually added to the above medium and their ability to support growth determined (Table I.)

TABLE I

Assimilation of Nitrogen Compounds as Sole Nitrogen Source by Cryptococcus Nigricans

Compound	Concentration	Growth 1)
Hydrolysed Casein 2)	0.08 mg/ml	55
$(NH_4)_2SO_4$	3.7 mg/ml	3
$NaNO_3$	7.4 mg/ml	92
NH_4NO_3	2.4 mg/ml	79
 Anthranilic acid	0.8 mg/ml	1
 Indole	0.8 mg/ml	0
 Urea	0.8 mg/ml	0
No nitrogen source	—	0

1) Growth units = 100 minus per cent transmission

2) Nutritional Biochemicals Corp., Cleveland, Ohio

Since a medium containing glucose and $NaNO_3$ was in itself unable to support growth, it became apparent that the role of yeast extract in the medium was more than that of nitrogen source. Consequently, a medium containing, in addition to glucose and $NaNO_3$, the known components of yeast extract (as determined by assay 4)), was tested. This chemically defined medium supported the growth of *C. nigricans* in the absence of yeast extract.

Since it was desirable to develop a minimal, defined medium, the vitamin mixture, the inorganic salt mixture and the purines and pyrimidines were individually omitted from the medium.

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4) The yeast extract assay was supplied by the Difco Company, Detroit, Michigan.

Thus it was found that the purines and pyrimidines were not required (Table II). It could be similarly demonstrated that among the vitamins tested, all but thiamin and biotin could be eliminated from the medium (Table III). The optimum concentrations for $NaNO_3$, thiamin, and biotin were then determined by adding varying concentrations of the compound in question to the minimal

TABLE II

Growth of Cryptococcus Nigricans in Defined Medium [1])

Component Omitted	Growth Units
none	47
vitamin mixture	1
inorganic salts	8
purines and pyrimidines	53

[1]) Complete Medium

1. Glucose	20 mg/ml
2. $NaNO_3$	2 mg/ml
3. *Vitamin Mixture*	
pyridoxine	5.0 μg/ml
Ca pantothenate	5.0 μg/ml
thiamin	5.0 μg/ml
nicotinic acid	5.0 μg/ml
PABA	5.0 μg/ml
biotin	0.5 μg/ml
riboflavin	5.0 μg/ml
4. *Salt Mixture* (See Table IV)	
5. *Purines and Pyrimidines*	
adenine	5 μg/ml
guanine	5 μg/ml
uracil	5 μg/ml

TABLE III

Vitamin Requirements of Cryptococcus Nigricans in Defined Medium

Basal Medium [1]) plus Vitamin Mixture [2]) omitting	Growth Units
pyridoxine	56
Ca pantothenate	63
thiamin	0
nicotinic acid	51
PABA	51
biotin	4
riboflavin	56
all vitamins	1
none	62

[1])

Glucose	20 mg/ml
$NaNO_3$	2 mg/ml
Salt mixture	1 mg/ml

[2]) Vitamin concentration

biotin	0.5 μg/ml
all others	5 μg/ml

defined medium deficient, with respect to the component tested (figure 1). The complete, minimal, chemically defined medium may be seen in Table IV.

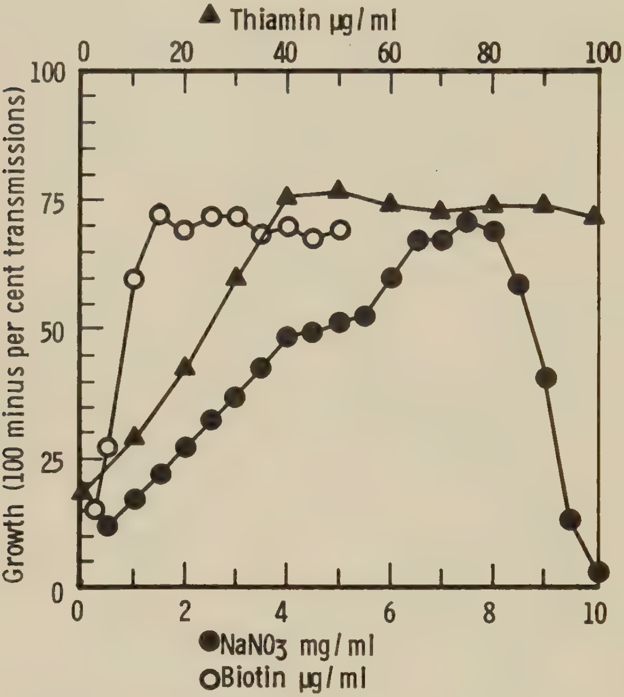

Fig. 1. The Effect of Thiamin, Biotin, and Sodium Nitrate on the Growth of *Cryptococcus nigricans* grown in suspension.

TABLE IV

Chemically Defined, Minimal Medium for Cryptococcus Nigricans

Component	Concentration/ml	
Glucose	20	mg
$NaNO_3$	7.5	mg
Biotin	1.5	µg
Thiamin.	50	µg
Salt mixture [1])	.01	ml

[1]) Inorganic salts mixture — Mg/ml of salt mixture

Inorganic salts mixture	Mg/ml of salt mixture
$K_2H\ PO_4$	100 mg/ml
$KH_2\ PO_4$	100 mg/ml
$MgSO_4 . 7H_2O$	40 mg/ml
NaCl	2.0 mg/ml
$FeSO_4 . 7H_2O$	2.0 mg/ml
$MnSO_4 . 7H_2O$	2.0 mg/ml

Optimum pH. To determine the optimum pH for growth of *C. nigricans*, appropriate volumes of 0.2 M buffer solutions (figure 2) were added to double strength defined medium and the volume adjusted with distilled water. pH determinations (Beckman Model G) were carried out after autoclaving of the medium. Constancy of pH after 6 days of incubation at pH 2.5, 3.5, 4.5, 5.5, and 6.5 indicated that the buffer concentration employed provided sufficient buffering capacity.

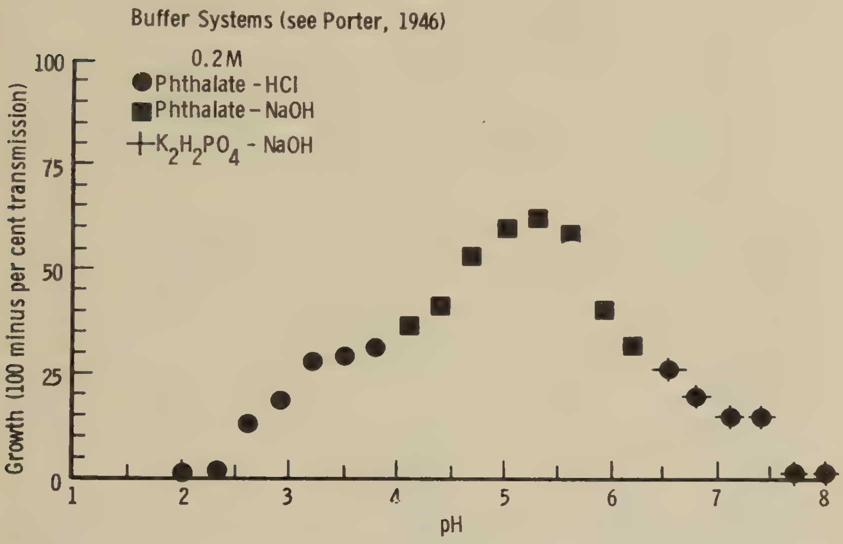

Fig. 2. The Effect of pH on Growth of *Cryptococcus nigricans* grown in suspension.

As can be seen from figure 2, the optimum pH was found to be between 5.0 and 5.6 [5].

Sensitivity to Antibiotics and Other Chemotherapeutic Agents. Although the absence of mouse pathogenicity (Rich & Stern, 1957) and growth at 37° C suggested that *C. nigricans* was a non-pathogenic *cryptococcus*, it seemed of interest to determine the effects of various antibiotics and other chemotherapeutic agents on its growth.

Concentrated suspensions of *C. nigricans* were added aseptically to molten Sabouraud-Dextrose agar in large (140 mm) petri plates. The plates were "dried" with the covers partially opened, at 37° C for two hours. Sensitivity discs (Difco) containing appropriate agents (Table V) were placed on the seeded agar surface of the plates which were then incubated at 28° C for seventy two hours and examined for zones of inhibition. Since the diameter of the zone is a function of the diffusion rate of the agent as well as the sensitivity of the microorganism, only the presence or absence of an inhibition zone was recorded.

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[5] The pH of the chemically defined medium described above was 5.4.

Sensitivity discs containing the anti-fungal agents, Mycostatin (Squibb), and Amphotericin A and B (Squibb) were not available. Therefore, 25 mg of each were placed on seeded agar plates, which, after incubation, were examined for zones of inhibition.

As can be seen from Table V, the anti-fungal Mycostatin and Amphotericins were inhibitory. It is interesting to note that Polymyxin B was also effective.

TABLE V

Sensitivity of Cryptococcus Nigricans to Antibiotics and other Chemotherapeutic agents

Agent	Concentration	Sensitivity [1])
Aureomycin.	30 mcg	—
Chloromycetin. . . .	30 mcg	—
Dihydrostreptomycin	100 mcg	—
Erythromycin	15 mcg	—
Penicillin	10 units	—
Polymyxin B	30 mcg	+
Terramycin	30 mcg	—
Tetracycline.	30 mcg	—
Bacitracin	20 units	—
Magnamycin	15 mcg	—
Neomycin.	30 mcg	—
Streptomycin	100 mcg	—
Viomycin	100 mcg	—
Mycostatin	25 mg	+
Amphotericin A. . .	25 mg	+
Amphotericin B. . .	25 mg	+
Sulfathiazole	300 mcg	—
Sulfadiazine.	300 mcg	—
Elkosin.	300 mcg	—
Gantrisin	300 mcg	—
Sulfamerazine	300 mcg	—
Thiosulfil	300 mcg	—
Triple sulfa	300 mcg	—
Furacin.	300 mcg	—
Furadantin	300 mcg	—
INH	25 mcg	—
PAS	100 mcg	—

[1]) + = sensitive
— = not sensitive

Discussion

Since it has been shown that the pH of the nutrient medium has a marked effect on capsule formation of *C. neoformans* (LITTMAN, 1958) as well as on specific oxidation reactions of *C. nigricans* [6], it was of considerable importance to determine the effect of pH on the cellular growth of this organism. While it would have been preferable to employ one buffer system, it was necessary to employ several to cover the desired range. It was thus necessary to consider the effect of the buffering compound, *per se*, on the growth of the organism. This was particularly true for the phthalate system which has been shown to be toxic for certain biological systems (KING & CHELDELIN, 1952). As a result of the overlap of buffer ranges it could be shown that under these experimental conditions employed, the buffering compounds were not inhibitory (figure 2).

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[6]) These will be described in a later paper of this series.

The requirement for thiamin by *C. nigricans* is in agreement with earlier studies carried out with encapsulated yeasts (ROBBINS & KAVANAGH, 1938, 1942; REID, 1949; LITTMAN, 1958). Although a marked species variation with respect to quantitative requirement has been demonstrated, it is of interest to note the forty thousand fold difference between the non-pathogenic *C. nigricans* (40μg/ml) and the pathogenic *C. neoformans* as recently reported by LITTMAN (1958).

Although ammonium nitrogen is more commonly assimilated than nitrate nitrogen by most yeasts (SKINNER et al., 1948), *C. nigricans* does not appear to be able to utilize ammonium nitrogen as sole nitrogen source, nor in the presence of nitrate nitrogen. This is suggested by the inability of the microorganism to assimilate ammonium sulfate [7] and the observation that cellular growth with ammonium nitrate occurred to the extent of the nitrate nitrogen present (Table I). The negative growth response to urea appears to be further evidence for the inability to utilize ammonium nitrogen, as it has been previously shown, that *C. nigricans* is capable of hydrolysing urea (RICH & STERN, 1958)

While it can be shown by sequential elimination of single amino acids from a mixture of twenty six, that the elimination of seven amino acids (arginine, cystine, valine, tyrosine, leucine, lysine, and phenylalanine) resulted in reduced growth (RICH, 1957), it could not be unequivocally concluded that a requirement for specific amino acids exists. One must consider that the diminished growth in the absence of certain amino acids (in the presence of others) could be due to the inhibitory-protective relationships brought about by amino acid imbalance as described by WERKMAN & WILSON, 1951. This explanation is supported by the improbability of a microorganism capable of synthesizing its nitrogenous needs from nitrate, in the absence of amino acids, requiring seven specific amino acids to replace nitrate. If this were indeed fact, it would be necessary to postulate a mechanism wherein nitrate would be converted to the seven specific amino acids (or their derivatives)

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7) An equivalent concentration of sodium sulfate was not inhibitory indicating that sulfate toxicity was not responsible for the inability to assimilate ammonium sulfate.

and where no interconversions of the amino acids or their precursors could occur. This appears improbable.

Summary

1. A chemically defined, minimal medium was developed for the cultivation of *Cryptococcus nigricans* (glucose, nitrate, thiamin, biotin, and inorganic salts).

2. Optimum temperature was found to be 29° C with upper and lower limits at 34° C and 23° C.

3. Optimum pH for growth was found to be pH 5.0—5.6.

4. Ammonium nitrogen was not assimilated.

5. *C. nigricans* was inhibited by Mycostatin, Amphotericin A and B, and Polymyxin B.

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THE INFLUENCE OF ANTIBIOTICS ON EXPERIMENTAL MONILIASIS.

I. Penicillin, streptomycin, chloramphenicol and viomycin.

by

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(28.VIII.1958)

INTRODUCTION

Candida albicans, a frequent inhabitant of the human gastro-intestinal tract, is generally regarded as a commensal. Following the widespread use of antibiotics, hormones and other chemotherapeutic agents, however, clinical moniliasis has become increasingly prevalent (Zimmerman, 1950, 1955; Nickerson, 1953; Bratlund & Holten, 1954; Cannon, 1955). The commonest infections are glossitis, pharyngitis and pruritus ani and vulvi, implying a fungal overgrowth on mucous membranes (Mountain & Krumenacher, 1953; Seletz, 1954, et al.). In a number of cases, haematogenous dissemination from such primary foci of infection results in the formation of metastatic lesions which exhibit no evolutive tendency and are often regressive (Mackinnon & Artagaveytia-Allende, 1956).

The causes of primary fungal overgrowth and of haematogenous dissemination are imperfectly understood. It is generally accepted that a partial sterilisation of the surface and contents of the gastro-intestinal tract follows administration of antibiotics. As a result, organisms unaffected by the therapeutic agent increase in quantity. Amongst these is *C. albicans* (Tomaszewski, 1951). The causes of such increase in population may be regarded as lack of competition and removal of the products of bacterial antagonists (Huppert, Macpherson & Cazin, 1953). The increase denotes the establishment of a high density of fungal inoculum at the surface of the host. Lienthal, Harris & Arnott, 1957, have suggested that subsequent colonisation of the underlying host tissue is the outcome of decreased resistance in the host owing to hormonal imbalance. Necrosis of the gastro-intestinal tract may be a sequel of avitaminosis B due to elimination of vitamin-synthesising bacteria. It has been suggested that sensitivity of the host to the fungus and/or antibiotic is a factor in genito-crural infections (Reiches, 1951). Although the stimulation of fungal growth rate and power of cellular division *in vivo* has been advanced as contributary, this has proved difficult to substantiate.

Antibiotic substances such as the tetracyclines, chloramphenicol, streptomycin, penicillin and others, whether used singly or in various combinations, have been implicated in focal and disseminated human, monilial infections. HUPPERT, CAZIN & SMITH, 1955, have recorded the establishment of *C. albicans* in the intestinal flora of mice following the oral administration of such antibiotics.

Using rodents as experimental models, enhancement of *Candida* infection by chlortetracyline was first described by SELIGMAN, 1952, and confirmed subsequently by others, notably BROWN, HAZEN & MASON, 1953, and WINTER & FOLEY, 1956. WINTER & FOLEY also recorded enhancement with oxytetracycline and tetracycline. Enhancement of fungal infection following the administration of hormones is well known (KASS & FINLAND, 1953). The work reported below deals with variations in the host/parasite relationships of experimental moniliasis of the mouse after treatment with penicillin, streptomycin, chloramphenicol and viomycin.

EXPERIMENTAL

The intraperitoneal route for the administration of antibiotics and fungal inoculum was selected to fulfil requirements simulating those found in human infections, namely the presence of a therapeutic agent and fungal inoculum at the surface of a host membrane.

(a) Antibiotics and their levels of tolerance.

The following antibiotics were administered intraperitoneally to mice of the outbred strain: — Streptomycin (Calcium Chloride Complex), Penicillin G, Viomycin Sulphate, Chloramphenicol B.P. Toleration of the drugs was estimated at levels lying between 50 mg. and 0.1 mg. in the case of streptomycin, viomycin and chloramphenicol in aqueous solution or suspension. Immediate toxic effects, recognisable by collapse, shallow rapid breathing and death within fifteen minutes, occurred with streptomycin at dosages of 50 mg. and 5 mg. Dosages of 2.5 mg. and 0.1 mg. resulted in a mild state of collapse followed by recovery. Viomycin was lethal at 50 mg. and showed mild toxicity at 5 mg., followed by recovery. Chloramphenicol was well tolerated at 50 mg., and penicillin at 5,000 units. Of 107 animals of outbred strain, 8 served as controls for the estimation of the long term effects of antibiotic treatment. Each animal received 2 injections of a given antibiotic followed by 0.5 ml. sterile water, 24 hours later; 2 received penicillin 500 units; 2 received 0.1 mg. streptomycin; 2 received 5 mg. chloramphenicol, and 2 received 0.5 mg. viomycin at each injection.

(b) Fungal isolates.

2 isolates of *C. albicans* from human sources, E_1 and C_2 (BLYTH, 1958), were used in the experiments. 17 animals were selected for estimating the pathogenicity of the isolates. 5 animals received

100,000 cells of isolate E_1, 3 received 1,000 cells; 5 were given 50,000 cells of isolate C_2 and 4, 1,000 cells of the same isolate. All inocula were suspended in 2 ml. sterile, distilled water.

(c) Antibiotic treatments.

82 animals were divided into two series, according to the fungal isolate administered.

E1 series.

37 animals were so divided that 10 (Group 1) received fungal inoculum at a density of 100,000 cells, and 27 (Group 2) received inoculum at a density of 1,000 cells.

Group 1

Each of 4 animals received an injection of one of the antibiotics (at dosages used in antibiotics controls), followed by fungal inoculum 24 hours later, i.e. where S = streptomycin, P = penicillin, Ch. = chloramphenicol, V = viomycin, SE_1; PE_1; $Ch.E_1$; VE_1.

Each of 4 further animals was given 2 injections of one of the antibiotics at intervals of 24 hours, followed by fungal inoculum 24 hours later, i.e. SSE_1; PPE_1; $Ch.Ch.E_1$; VVE_1.

Two animals received an 'all antibiotics' treatment consisting of streptomycin, followed by penicillin, chloramphenicol and finally viomycin, each injection being spaced at an interval of 24 hours, followed by fungal inoculum 24 hours later, i.e. $SPCh.VE_1$.

Group 2

Each of 5 animals received an injection of 50 mg. of chloramphenicol, followed after 24 hours by fungal inoculum, i.e. $Ch.E_1$.

Five animals each received a single injection of streptomycin at a dosage of 2.5 mg. and fungal inoculum 24 hours later, i.e. SE_1.

Five animals were each given 5 mg. viomycin, followed by fungal inoculum 24 hours later, i.e. VE_1.

Six animals received 5,000 units of penicillin, followed by fungal inoculation after 24 hours, i.e. PE_1.

Five animals received the 'all antibiotics' treatment $SPCh.VE_1$.

C_2 series.

45 animals were divided to give a batch of 18 (Group 3) and a batch of 27 (Group 4).

Group 3.

Dosages of antibiotics were those used in antibiotics controls. Fungal inoculum was administered at a density of 50,000 cells.

Streptomycin.

Of 3 animals, 2 were given 2 injections of the drug at 24 hour intervals, followed 24 hours later by fungal inoculum. 1 of the 2 received a further drug injection after 24 hours, i.e. SSC_2 and SSC_2S. The remaining animal received an injection of streptomycin, followed after 24 hours by fungal inoculum, and 24 hours later by streptomycin, i.e. SC_2S.

Viomycin and Penicillin.

Four animals were selected for treatment with viomycin.

One animal received the antibiotic followed by inoculum of the fungus after 24 hours, i.e. VC_2. 1 animal received 2 spaced injections of the antibiotic followed by fungal inoculation after 24 hours, i.e. VVC_2. 1 animal was given 2 spaced injections of the antibiotic followed by fungal inoculation after 24 hours, and a further injection of the drug 24 hours later, i.e. VVC_2V. 1 animal received, at intervals of 24 hours, an injection of the drug, fungal inoculation and another injection of the antibiotic, i.e. VC_2V. 4 further animals were treated in a similar way with penicillin, i.e. PC_2, PPC_2, PPC_2P, PC_2P.

Chloramphenicol.

Of 4 animals, 2 received 2 injections of the antibiotic at a 24 hour intervals, followed by fungal inoculum 24 hours later, i.e. Ch.Ch.C_2. The remaining 2 mice were given a single injection of the antibiotic followed by fungal inoculum after 24 hours, i.e. Ch.C_2.

All Antibiotics.

Three animals received injections of all four antibiotics, administered at intervals of 24 hours, followed 24 hours later by fungal inoculum, i.e. SPCh.VC_2.

Group 4.

The same schedule of treatment was applied as in Group 2 above, isolate C_2 replacing E_1. 5 animals received Ch.C_2, 6 animals SC_2, 5 animals VC_2 and 5 PC_2. 6 animals were given the 'all antibiotics' treatment, SPCh.VC_2.

(d) Duration of the experiment.

Surviving animals in Groups 1 and 3 were sacrificed on the fortieth day from the date of fungal inoculation, those in Groups 2 and 4 on the seventyfifth day. During the progress of the experiment, the animals were kept at 63° F, and allowed unlimited water and standard rat cake.

RESULTS

1. Numerical.

The numerical results of the entire experiment are given in Table I.

All control animals receiving high density fungal inoculum died; with one exception (that inoculated with isolate E_1), all receiving low density inoculum survived. The control animals used for the estimation of the effects of antibiotics survived, and were still healthy after a period of six months. The greatest mortality in the total number of animals inoculated with *C. albicans* (both types) and treated with antibiotics, occurred where streptomycin alone

TABLE I

Nos. of mice inoculated with *C. albicans*	Fungal Isolate	Antibiotic Treatment	Nos. of deaths due to moniliasis.	Nos. of deaths according to fungal isolate.
17	$8E_1$ $9C_2$	—	11	$6E_1$ $5C_2$
17	$8E_1$ $9C_2$	Streptomycin	9	$3E_1$ $6C_2$
17	$8E_1$ $9C_2$	Penicillin	1	$1E_1$
16	$7E_1$ $9C_2$	Chloramphenicol	3	$3C_2$
16	$7E_1$ $9C_2$	Viomycin	5	$2E_1$ $3C_2$
16	$7E_1$ $9C_2$	'all antibiotics'	11	$6E_1$ $5C_2$
No deaths were recorded in 8 animals treated with antibiotics alone.				

was used, or where it was incorporated in a schedule including penicillin, viomycin and chloramphenicol ('all antibiotics'). The mortality recorded with these treatments was approximately equivalent to that attributable to the fungus alone.

Penicillin, chloramphenicol and viomycin afforded considerable protection against infection, the lowest mortality arising in animals treated with penicillin.

The results of individual antibiotic treatments and a record of animal disease reaction (BLYTH, 1958) are given in Tables II and III. In the E_1 series (Table II), enhancement of infection, as indicated by reduced time of survival, occurred in Group 1 when an 'all antibiotics' treatment was given. The same treatment, when applied in Group 2 animals, resulted in increased mortality. Disease reaction is given as acute (pyelonephritis and myocarditis) and chronic (pyonephrosis). It appears that the protective action of penicillin, chloramphenicol and viomycin results in the replacement of the expected acute reaction of controls by one which is chronic in the animals of Group 1. An expected chronic reaction prevails in the Group 2 animals.

In the C_2 series (Group 3), a dramatic enhancement of infection occurred in animals treated with streptomycin where the chronic reaction of fungal controls is replaced by an acute reaction, giving a marked decrease in time of survival. A lesser enhancement was recorded in animals treated with viomycin and 'all antibiotics' without accompanying change in disease reaction. In Group 4,

TABLE II

E_1 Series	Fungal Inoculum density	No. of animals inoculated	Antibiotic treatments	No. of deaths due to moniliasis	Survival in days from time of fungal inoculation	Disease Reaction	
						Acute	Chronic
CONTROL	100,000	5	—	5	6—9	5	0
GROUP 1	100,000	10	SE_1 SSE_1	1 1	8 9	1 1	0 0
			PE_1 PPE_1		∞ ∞		
			Ch. E_1 Ch. Ch. E_1	1 1	∞ 3 (also showing bacterial infection)	0 1	1 0
			VE_1 VVE_1	1 1	19 22	0 0	1 1
			SPCh.VE_1(2 animals)	2	1&4	2	0
CONTROL	1000	3	—	1	∞	0	1
GROUP 2	1000	27	SE_1 (6 animals)	1	∞	0	1
			Pe_1 (6 animals)	0			
			Ch. E_1 (5 animals)	0			
			Ve_1 (5 animals)	0			
			SPCh.VE_1 (5 animals)	4	∞	0	4
TOTALS		45		19		10	9

TABLE III

C_2 Series	Fungal Inoculum density	No. of animals inoculated	Antibiotic treatments	No. of deaths due to moniliasis	Survival in days from time of fungal inoculation	Disease Reaction	
						Acute	Chronic
CONTROL	50,000	5	—	5	18—30	0	5
GROUP 3	50,000	18	SSC_2	1	2	1	0
			SSC_2S	1	7	1	0
			SC_2S	1	6	1	0
			PC_2				
			PPC_2		showed infection at autopsy	0	1
			PC_2P	1	20	0	1
			PPC_2P				
			$Ch.C_2$				
			$Ch.C_2$				
			$Ch.Ch.C_2$	1	27	0	1
			$Ch.Ch.C_2$	1	30	0	1
			CV_2	1	13	0	1
			VVC_2		3 (peritonitis?)		
			VVC_2V	1			
			CV_2V	1	15	0	1
			$SPCh.VC_2$ (3 animals)	2	16 & 16	0	2
CONTROL	1000	4	—	0			
GROUP 4	1000	27	SC_2 (6 animals)	3	∞	0	3
			PC_2 (5 animals)	0			
			$Ch.C_2$ (5 animals)	1	∞	0	1
			VC_2 (5 animals)	0			
			$SPCh.VC_2$ (6 animals)	3	∞	0	3
TOTALS		54		23		3	20

where control animals showed neither morbidity nor mortality, enhancement occurred following treatment with streptomycin and 'all antibiotics', and, to a much lesser extent, with chloramphenicol.

It may be concluded that enhancement of infection occurs in animals receiving both infective and sub-infective dosages of fungal inocula, when prior treatment with streptomycin alone or in combination with penicillin, chloramphenicol and viomycin, has taken place. No correlation exists between fungal infection and any particular daily schedule of administration of an antibiotic substance. Lesser enhancements of infection follow viomycin treatment where infective dosages of fungal inoculum are used. The protection afforded by penicillin, chloramphenicol and viomycin is operative at both infective and sub-infective dosages of fungal inoculum.

2. Histopathology.

Material from all animals dying during the experimental period was fixed in formalin neutral. Batches of microtome sections were stained with haematoxylin and eosin, or with carbol thionin blue followed by orange G, or with KLIGMAN'S modified acid-Schiff stain (CONANT et al., 1954). Renal and cardiac lesions received particular study.

(*a*) *Fungal control animals.*

In the Group 1 animals of the E_1 series, fungal controls showed a typical acute disease reaction characterised by the development of numerous cortical and medullary abscesses of the kidney and multiple abscesses of the heart (Figs. 1 & 2). The control animals of Groups 2, 3 and 4 exhibited a chronic disease reaction in which renal cortical abscesses were absent. A few medullary lesions were present, but profuse pseudomycelium and blastospores of the fungus occluded the lumen of the renal pelvis, causing cavitation of the medulla (Fig. 3). The heart showed no sign of involvement. The typical abscess found in the acute disease reaction consists of a central area of necrosed host tissue containing elements of the fungus in predominantly transitional form (BLYTH, 1958). Occasionally, where the centre of the abscess incorporates uriniferous tubules not subject to leucocytic infiltration, a basic pseudomycelium of predominantly monaxial growth produces localised verticils of blastospores. Surrounding the immediate centre of the abscess is a broad zone of polymorphs in which transitional pseudomycelium of verticillate growth constricted at the septa, predominates. Where necrosis of polymorphs and tubular tissue is present, some cells of the transitional mycelium undergo fragmentation; others become dilated and vacuolate, and assume the morphology of bladder-cells. The periphery of the abscess shows numerous histiocytes and a few lymphocytes, and the fungus is principally in the form of bladder-

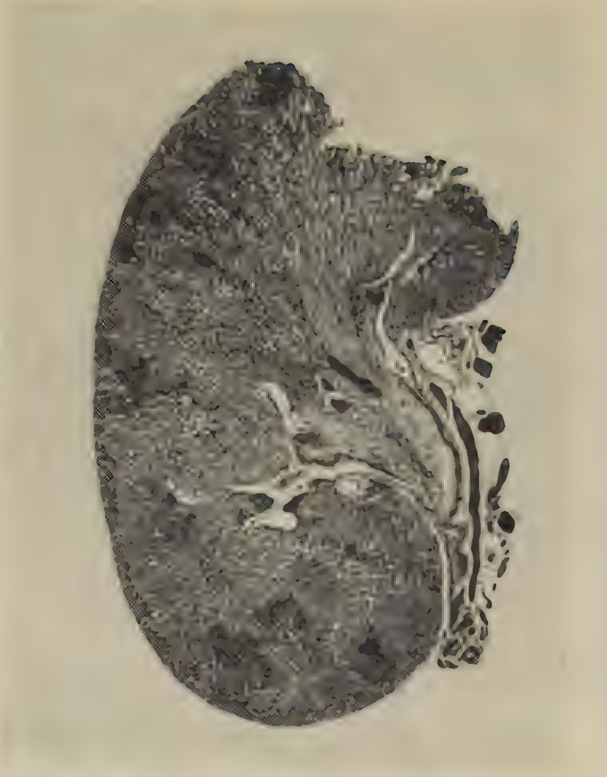

Fig. 1. Section of a kidney from a mouse inoculated with *C. albicans*, isolate E_1, showing the acute disease reaction. Abscesses are cortical and medullary.

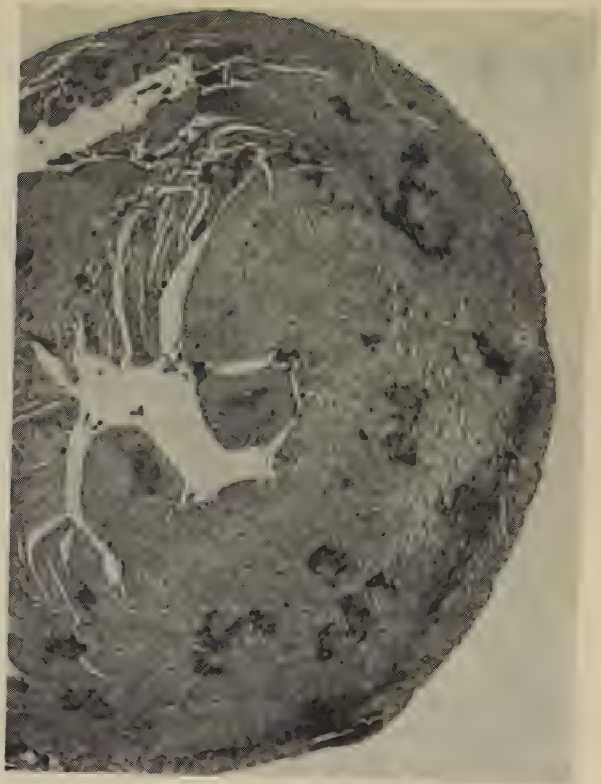

Fig. 2. Section of the heart of the same animal. Abscesses are present in the myocardium.

cells. Small chains of blastospores produced from the terminal branches of transitional pseudomycelium are also present. In some control animals, the lesion is more granulomatous in nature, and fragmentation and bladder-cell phases predominate. The occurrence of such phases is regarded as indicative of arrest in fungal growth as a result of an efficient host response.

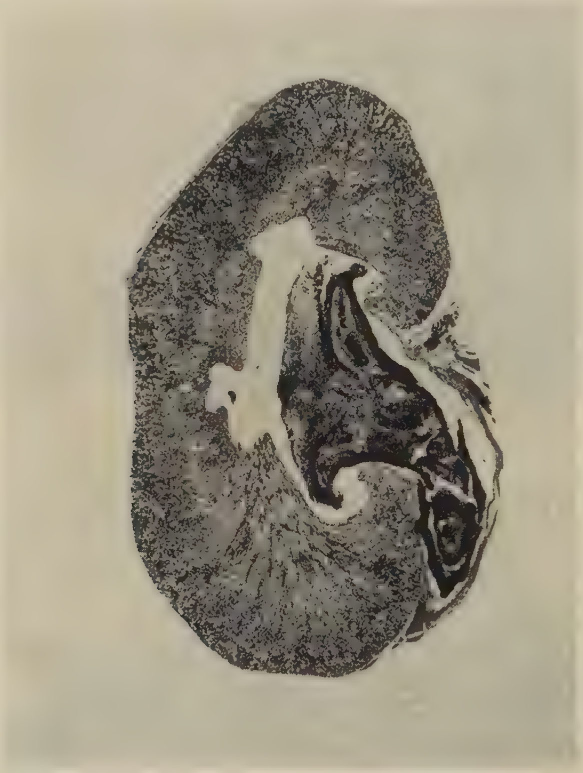

Fig. 3. Section of a kidney from a mouse inoculated with *C. albicans*, isolate C_2, showing the chronic disease reaction. Pseudomycelium and blastospores have occluded the urinary pelvis; the medullary tissue shows cavitation due to fungal colonisation.

In the cavity of the renal pelvis, the basic pseudomycelium of the fungus, together with its accompanying blastosporic phase, is profuse in animals showing the chronic disease reaction. In animals suffering acute infection, renal pelvic colonisation is minimal.

Myocardial abscesses, typical of the acute disease reaction, are small, showing efficient mobilisation of leucocytes. Necrosis of muscle fibres is usually intense. The fungus is in transitional form towards the centre; bladder-cell development predominates towards the periphery.

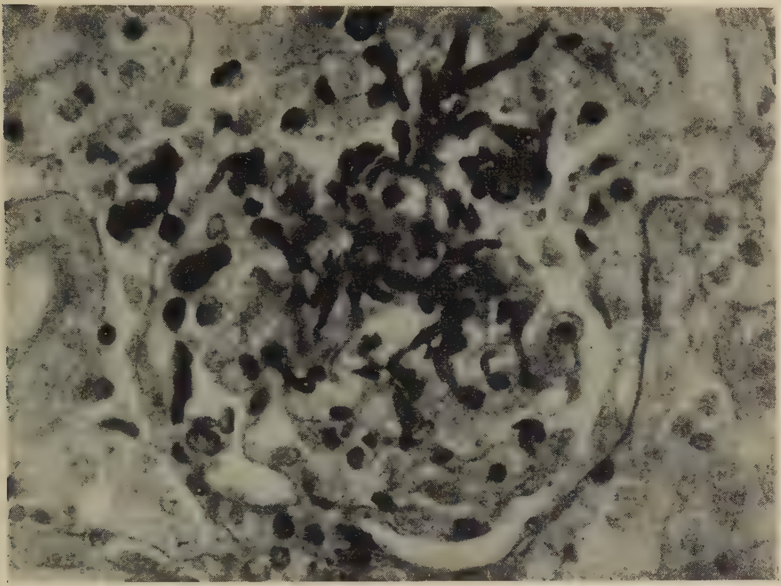

Fig. 4. Part of the kidney of a mouse given SPCh. VE_1 treatment. Time of survival was one day. Fungal pseudomycelium colonises tubular tissue from a glomerulus.

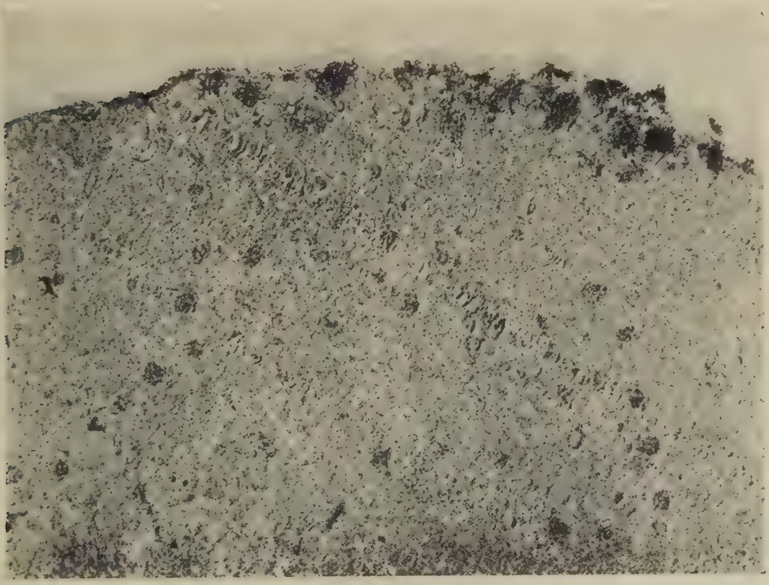

Fig. 5. Direct fungal penetration from the peritoneal cavity of a kidney of the above animal.

(*b*) *Infection in relation to antibiotic treatments.*

In the E_1 series, Group 1, animals treated with streptomycin SE_1, SSE_1, show a range of inflammatory reaction and fungal morphology comparable to that described above for fungal control animals. Enhancement of fungal infection occurred in this group in the two animals given the 'all antibiotics' treatment $SPCh.VE_1$.

The animal which died after 24 hours showed no gross pathology at autopsy. The fungus was present, however, at numerous locations in the kidney in an immediately post germinative state of transitional mycelium arising chiefly from glomeruli (Fig. 4). Even at this stage, tubular necrosis and early mobilisation of leucocytes were observable. In one kidney there was direct penetration from the peritoneal cavity through the renal capsule (Fig. 5). A widespread diffuse leucocytic infiltrate occurred in the myocardium independently of numerous radiating colonies of fungal pseudomycelium arising from capillaries. These colonies showed marked invasive growth of muscle fibres, and towards their peripheries, appeared in the form of basic pseudomycelium. Early stages in the necrosis of musculature were widespread (Fig. 6). Germinating blastospores were also observed in the lungs and liver. The cause of death was presumably myocarditis.

The second of the two animals survived for four days; at autopsy, it showed multiple abscessing of the kidneys and heart. The cortical and medullary tissues of the kidney (Fig. 7) were widely permeated by fungal elements of basic pseudomycelial morphology; blastospores were profuse. Irregular zones of leucocytes occurred at the margins of separate centres of fungal growth which, in these areas, assumed transitional form with a sporadic bladder-cell development. Direct penetration from the peritoneal cavity had also occurred. The myocardium showed a general leucocytic infiltration, and intense necrosis of muscle fibres in areas invaded by radiating mycelial colonies (Fig. 8). Morphologically, the pseudo-hyphae were predominantly transitional; a weak bladder-cell development was present in areas of necrotic host tissue. Direct fungal penetration of the spleen was observed in this animal.

In animals of the C_2 series, Group 3, enhancement of infection followed administration of streptomycin. The animal receiving SSC_2 treatment was devoid of visible lesions at autopsy, two days after fungal inoculation. In section, numerous small fungal colonies occurred in the cortices of both kidneys. Transitional pseudomycelium had arisen in glomeruli, and a sparse infiltrate of polymorphs and histiocytes was present in the areas of fungal invasion. Direct penetration of a small area of one kidney and of peri-renal adipose tissue had taken place. In the heart, the myocardium showed numerous in vasive colonies of the fungus derived from blastospores which had germinated in capillaries (Fig. 9). Towards the centre of each colony, fungal elements were transitional, but towards the periphery, they became monaxial in growth form.

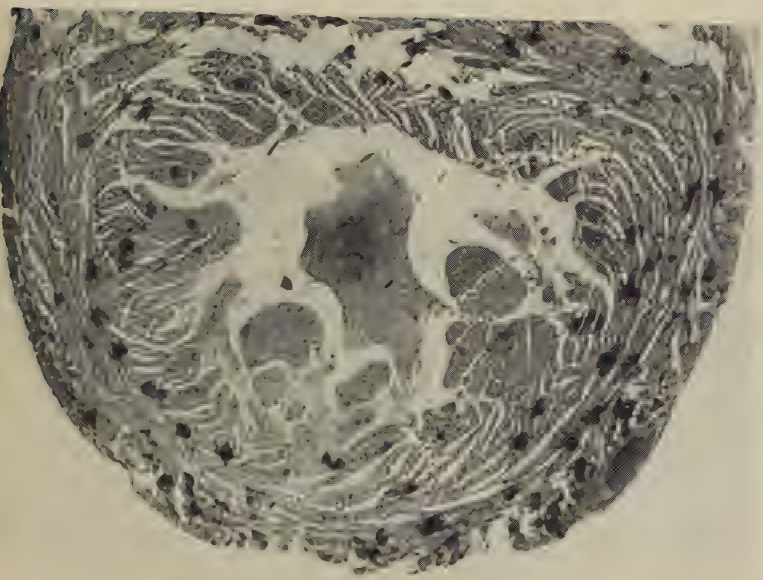

Fig. 6. Fungal colonies in the myocardium of the same animal.

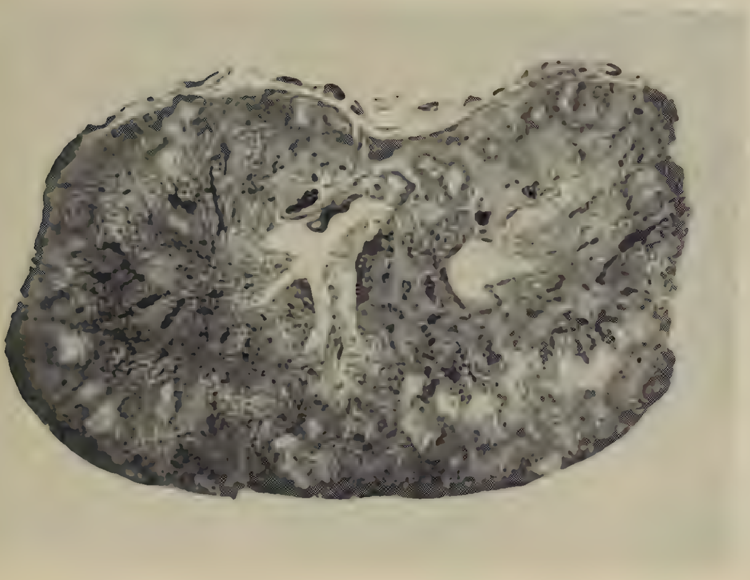

Fig. 7. Section of a kidney of a mouse given SPCh. VE_1 treatment. Time of survival was four days. Fungal colonies are numerous and spatially limited by irregular zones of leucocytes.

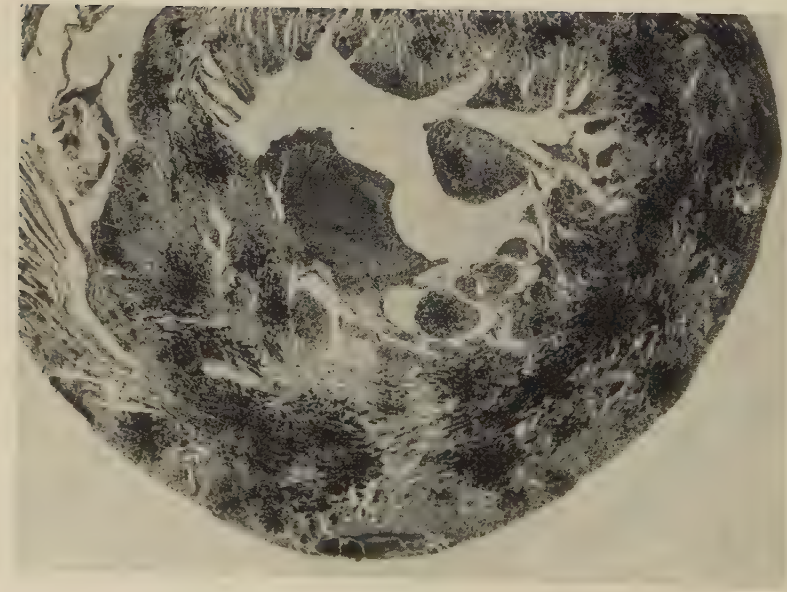

Fig. 8. Fungal colonies in the myocardium of the same animal.

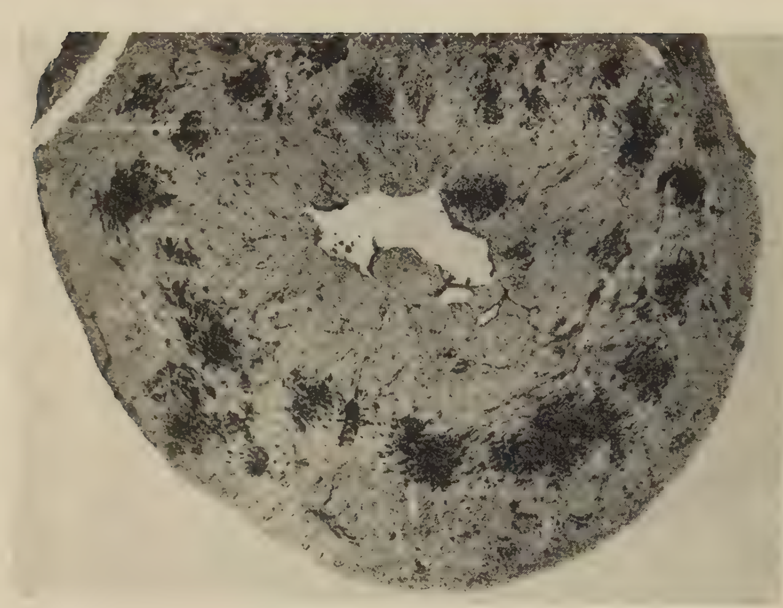

Fig. 9. Fungal colonies in the myocardium of a mouse given SSC_2 treatment.

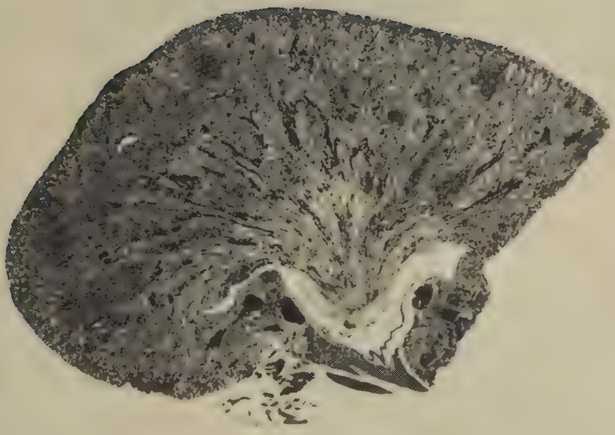

Fig 10. Section of the kidney of a mouse given SC_2S treatment, showing numerous small abscesses of the cortex and medulla.

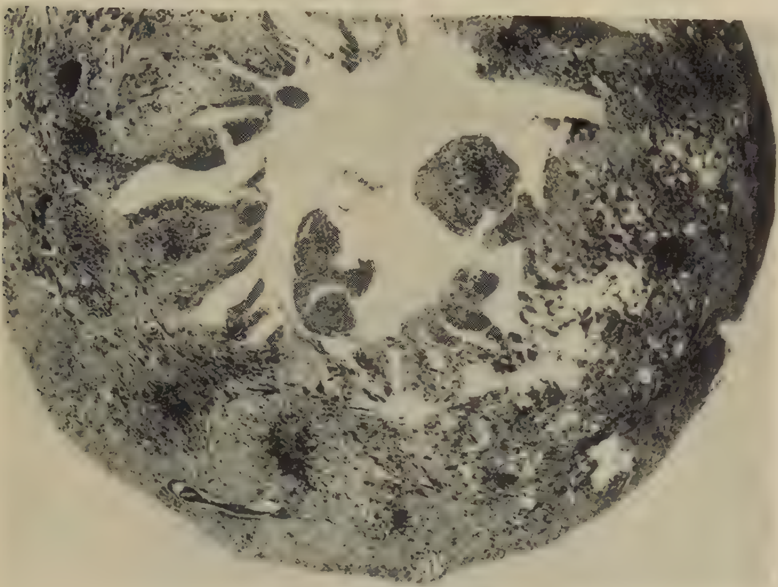

Fig. 11. Myocardial abscesses in the same animal.

Diffuse infiltration of leucocytes, and widespread early necrosis of muscle fibres were in evidence. Death was presumably due to myocarditis. Early stages in the germination of blastospores were plentiful in the liver and lungs.

The two remaining animals showing enhancement of infection survived for six days (SC_2S) and seven days (SSC_2S). The former had kidneys showing an extremely dense development of small cortical and medullary abscesses (Fig. 10). The predominant fungal morphology was transitional; bladder-cell development was sporadic in occurrence. A similar fungal development occurred within the heart, at the centres of very numerous abscesses of the myocardium (Fig. 11).

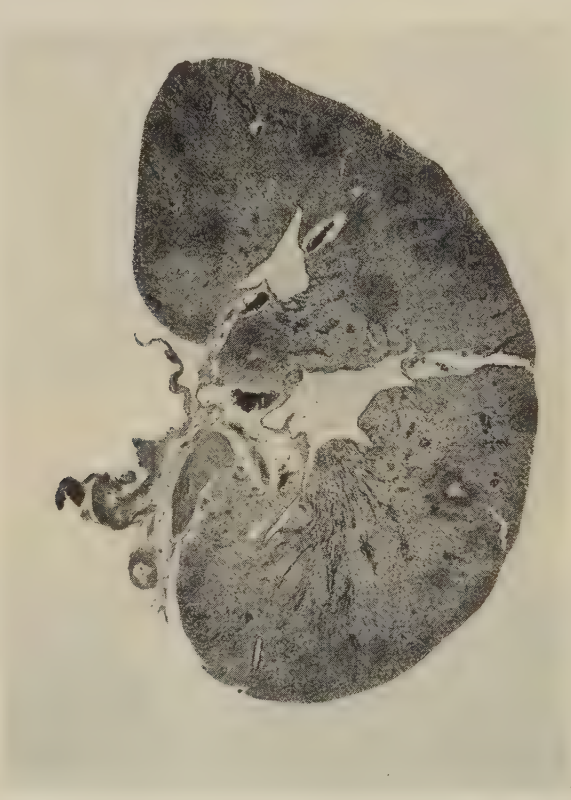

Fig. 12 Section of the kidney of a mouse given SSC_2S treatment. Compact, sperical abscesses are predominantly cortical.

In the animal receiving a SSC_2S treatment, numerous, compact, spherical abscesses occurred within the cortices of both kidneys (Fig. 12). Each abscess showed a broad central area of fungal elements of bladder-cell form giving a pseudoparenchymatous appearance. An unusually dense zone of polymorphs and histiocytes surrounded the pseudoparenchyma. Abscesses of the myocardium were similar to those of the kidneys, with bladder-cells prevalent within areas of necrotic polymorphs and muscle fibres.

In both animals myocarditis is suggested as the cause of death. The other treated animals which died during the course of the experiment showed a typical chronic disease reaction, indistinguishable from that of fungal controls.

Definition of enhancement of infection and its characteristics.

A true enhancement of infection in moniliasis of the mouse, brought about by antibiotic treatment, is regarded as a phenomenon which significantly alters the host/parasite relationships characteristic of animals inoculated with the fungal pathogen alone. In an animal receiving a high density of inoculum and expected to display an acute disease reaction, enhancement results in death prior to the formation of visible abscesses in any organ. Where, on the other hand, disease is expected to be chronic, enhancement results in an acute disease reaction with or without the development of visible abscesses at the time of death. The apparent enhancement which may occur irrespective of change in disease reaction, is not considered comparable; this type of enhancement occurred in Group 3 animals receiving viomycin or an 'all antibiotics' treatment.

In the animals which died one, two and four days from the date of fungal inoculation following treatment with streptomycin or 'all antibiotics', the following sequence of events appears to have taken place. A rapid haematogenous dissemination has presumably occurred from the peritoneal cavity followed by the early lodgment of blastospores in a variety of tissues throughout the body. After lodgment, germination of blastospores has resulted in the development of numerous, invasive fungal colonies, in which the process of growth in pseudohyphae exceeds that of cellular division. Consequently, the fungus appears in a mycelial and not a yeast (blastosporic) phase.

The significant features of the sequence are those concerned in the phase of primary lodgment leading to the establishment of colonies. The fact that direct fungal penetration of the kidney was observed in these animals suggests that some basic host defence mechanism has been affected by the administration of antibiotics. WINTER & FOLEY, 1956, have recorded direct fungal penetration of the kidneys of mice treated with chlortetracycline, oxytetracycline, and cortisone, but not a concomitant haematogenous dissemination of blastospores. The disturbance to this defence mechanism allows of a rapid penetration of tissue from germ tubes produced by germinating blastospores. The mechanism may have an allergic or sensitivity basis, as it is known that various antibiotics and a wide range of other substances are leucopenic, and may give rise to acute reactions in man involving the ulceration of mucous membranes (HECK, 1955).

Minor necrotic changes in membranes might account for the numerous penetrations of tissue which take place. Otherwise, impairments in the normal functions of the reticulo-endothelial system may be involved.

The diapedesis of polymorphs and subsequent mobilisation of histiocytes in relation to fungal colonisation do not appear to be affected. Leucocytic infiltration has occurred after only twenty four hours, an event not observed by WINTER & FOLEY, 1956, in animals sacrificed 24 hours after receiving fungal inoculum alone. The fungus in an area of polymorphs and histiocytes normally shows intense verticillation resulting in reduced monaxial growth, and subsequent spatial colonisation of tissues in untreated animals (BLYTH, 1958). Where antibiotics have been used, monaxial growth continues, suggesting impairment of the normal function of phagocytes akin to that reported in human tissues treated with cortisone and ACTH by REBUCK & MELLINGER, 1953. Alternatively, enhancement of the rate of fungal growth may be contributory. TARBET et al., 1953, have isolated serum factors potentiating the growth of *Candida tropicalis*, *in vitro*, from guinea pigs treated with various hormones and antibiotics.

Should the animal survive for as long as four days from the time of fungal inoculation, the kidneys are widely colonised by fungal elements of basic pseudomycelial form producing small verticils of blastospores. As this type of fungal development is otherwise restricted to the lumina of urinary pelves, or uriniferous tubules, it is considered to develop in the areas of host tissue devoid of effective mechanisms of defence. Curtailment of such fungal growth in treated animals appears to be brought about by a second mobilisation of leucocytes in areas at a distance from the primary sites of lodgment and germination of blastospores. This results in the presence of visible lesions at the time of death.

Where treated animals survive for six days or more, the first leucocytic infiltrate has effectively contained the fungal mycelium in its original area of establishment. A typical acute disease reaction is evident at the time of death.

The death of an animal showing true enhancement of infection is due to a rapid and abnormally extensive fungal colonisation of the myocardium. Whether death is due to myocarditis in a classical sense, or to the inhibition of muscular contraction owing to mechanical interference by fungal pseudomycelium, is not clear.

DISCUSSION

The action of antibiotics in modifying the progress of experimental moniliasis of the mouse involves alteration of some basic host defence mechanism. The normal defence mechanism in a susceptible animal inoculated with a pathogenic isolate of *C. albicans* alone can be modified by variation of the density of fungal inoculum administered. High densities of inoculum induce an acute disease reaction; low densities induce a chronic disease reaction, or are not infective. The alteration of the defence mechanism apparently negates the factor of density of fungal inoculum. It also affects fungal pathogenicity. SELIGMAN, 1952, 1953, has reported infection of mice by non-pathogenic isolates of the fungus following treatment with chlortetracycline. The true enhancement of infection brought about by streptomycin and 'all antibiotics' treatments was operative at infective dosages of inoculum, and is very similar to that described by MANOWSKI & LITTLETON, 1954, in mice treated with cortisone and ACTH.

The defence mechanism of the mouse may be similar to that in man. Most terminal cases of disseminated moniliasis show an acute type of disease reaction. GERLOCZY et al., 1956, however, described an infection similar to the chronic disease reaction in an infant showing haematogenous dissemination from a clinically healed thrush to the lungs and to the left renal pelvis which became occluded by a mass of fungal elements.

The resistance determined by the defence mechanism in the mouse can apparently be increased or depressed by antibiotic treatment, as it has been shown that prior administration of a small dose of penicillin, chloramphenicol, and, to a lesser extent, viomycin, may afford either complete protection against fungal infection, or may induce chronic rather than acute disease. Zymosan, malucidin, mucin and other substances have been shown to protect mice against *K. pneumoniae* and *M. pyogenes* when administered at various periods before inoculation by KISER et al., 1956, who note that malucidin was reported by PARFENTJEV et al. to protect mice if administered one or two days before inoculation with *C. albicans*. The protection afforded by chlortetracycline in mice inoculated intravenously with the fungus was described by SELIGMANN, 1953. Similar effects were noted by WINTER & FOLEY, 1956, in mice treated with chlortetracycline or cortisone, where direct fungal penetration of the kidney from the peritoneal cavity preceded a late and reduced haematogenous dissemination. The protective effects of cortisone, as indicated by reduction in dissemination value in moniliasis of the mouse are also known (SCHERR, 1953).

The enhancement of infection induced by prior administration of streptomycin or an 'all antibiotics' treatment, has shown that modification of the host defence mechanism is probably governed by times of application of treatment and fungal inoculum. Treatment preceded fungal inoculation by 24 hours. SELIGMANN, 1952, found that enhancement operated when chlortetracycline was administered 24 hours before to 4 hours after fungal inoculation. Antibiotic treatment from 8 to 24 hours after inoculation had no effect. Jackson & Axelrood, 1954, recorded greatly increased mortality in chick embryos treated with chlortetracycline, oxytetracycline or chloramphenicol 24 hours before inoculation with *C. albicans*.

It has been shown that in some animals, streptomycin and 'all antibiotics' treatments modify the host defence mechanism in such a way that unrestricted fungal colonisation, as indicated by monaxial growth and the assumption of a basic pseudomycelial morphology, develops even though leucocytic infiltration has occurred. Final restriction of the fungal colony is due to a second infiltration observable four days from the time of fungal inoculation. This sequence of events is paralleled by that described by Hestrin, 1956, in mice treated with levan, and subsequently infected with *M. pyogenes*. In the treated animals, radial spread from the site of inoculation resulted from impairment in the diapedesis of leucocytes. Invasion had proceeded for several hours without opposition from local concentrations of defence forces.

The host defence mechanism would appear to fall within the scope of the non-specific defence reaction investigated by Miles, 1956, in bacterial infections of the guinea pig following dehydration shock and administration of adrenalin or Liquoid.

It is noticeable that, although the dosages of streptomycin and viomycin used prior to fungal inoculation, were far below levels normally regarded as toxic for mice, a mild, transient, anaphylactic state followed their administration. This may have played a part in the modification of basic host resistance. That streptomycin affects resistance of the host by allowing small numbers of organisms to bring about infection of laboratory animals in the case of *Salmonella enteritidis* has been demonstrated by Bohnhoff et al., 1954. Dick, 1953a, and 1954, has described a number of tissue changes induced by streptomycin, P.A.S. and isoniazid in human renal tuberculosis. In the field of plant pathology, Bonde & Malcolmson, 1956, observed increased *Fusarium* and *Phoma* rots of potato seed-pieces treated with streptomycin. The fungus grew more rapidly on treated than on untreated potato tissue.

The stimulation of the growth rate of *C. albicans* in vivo by antibiotic substances is difficult to substantiate. *In vitro*, Meyer-Rohn & Lange-Brock (1957) have recorded stimulation in synthetic nutrient solution by bacitracin and streptomycin, and a weaker stimulation by penicillin and chloramphenicol. No increase in growth rate occurred with oxy- of chlor-tetracycline. The latter two substances and also tetracycline, however, were found to provide a nitrogen source for the fungus by Gram (1956). The fungus did not grow when penicillin or streptomycin was provided as an alternative source. Huppert, Macpherson & Cazin, 1953, reported stimulation in broth cultures augmented by chlortetracycline, but not by penicillin, chloramphenicol, streptomycin or oxytetracycline. The conflicting nature of such reports emphasises the difficulty of accepting increase in fungal growth rate as a factor in enhancement of infection, following treatment with one or more antibiotics.

Acknowledgements

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A COMPARATIVE STUDY OF THE APICULATE YEASTS.

by

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(4.VIII.1958)

Introduction

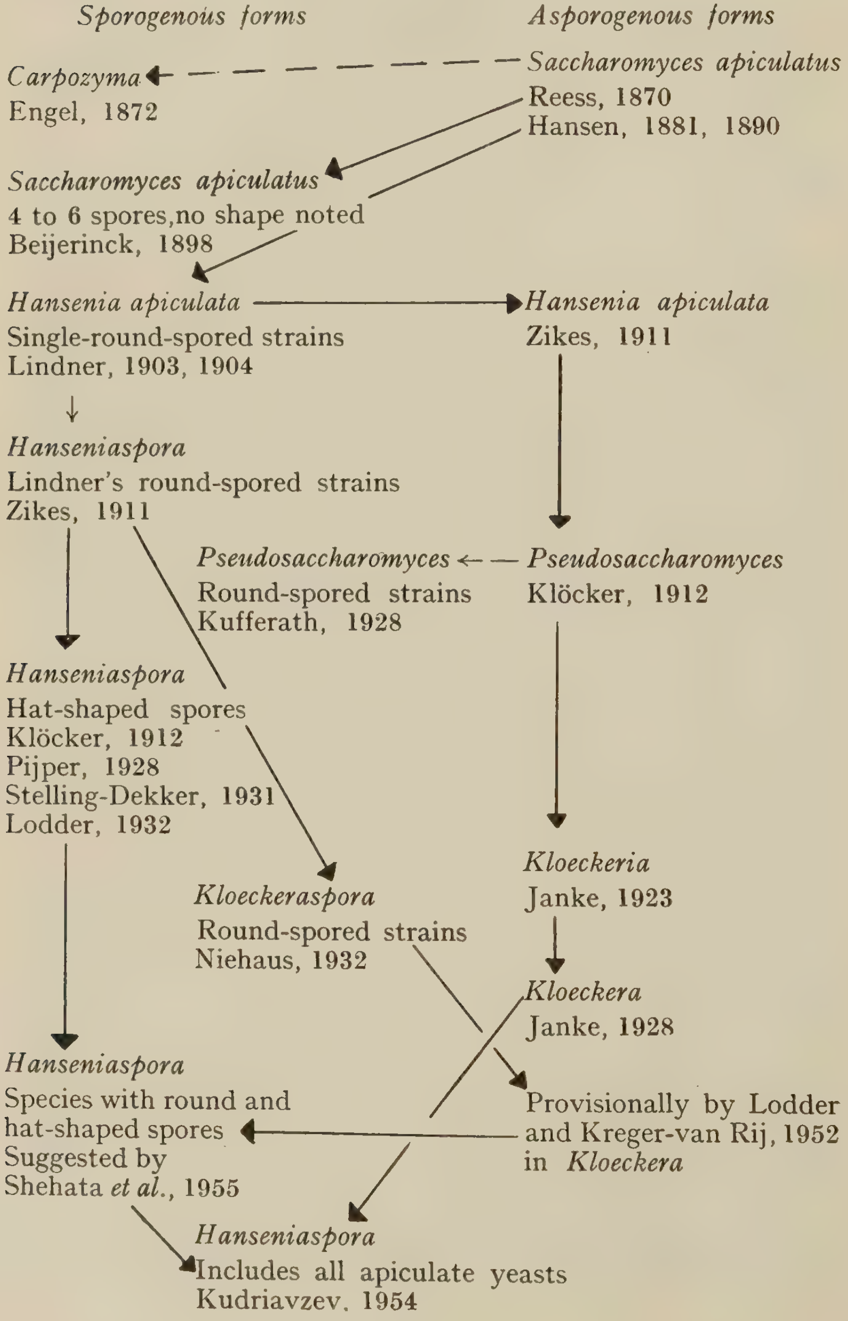
The tribe *Nadsonieae* in the subfamily *Saccharomycetoideae* was established by Stelling-Dekker (1931). She placed in this tribe the genera *Saccharomycodes*, *Nadsonia* and *Hanseniaspora*. Characteristics, which the three genera have in common, are lemon shaped vegetative cells which reproduce at the poles by a process intermediate between budding and fission. The tribe *Nadsonieae* was retained without change by Lodder & Kreger-van Rij (1952). Such a grouping implies a natural relationship between the genera. The only characters, however, which this group possesses in common are the cell shape and the manner of budding. The same characteristics separate the genus *Kloeckera* from other asporogenous genera.

The history and nomenclature of *Saccharomycodes* and of *Nadsonia* is simple and clear-cut. The extensive literature concerning the classification of *Hanseniaspora* and *Kloeckera* has led to a confusion in nomenclature. The disagreement between investigators with respect to the ability of these yeasts to form ascospores is principally responsible for this. The following chart shows the historical development of the nomenclature of the two genera.

The life cycles of *Saccharomycodes* and *Nadsonia* are well known and are very different from each other. The life cycle of *Hanseniaspora*, on the other hand, has not been worked out. There is even a disagreement in opinions as to the true nature of the spherical "spores" which are formed by certain species of *Hanseniaspora* (see e.g. Lodder & Kreger-van Rij, 1952).

Species of *Kloeckera* have been separated primarily on the basis of cell size and/or physiological properties. Klöcker (1912) described a large number of species in this genus on the basis of minor differences in cell dimensions and morphology. Lodder (1934) reduced the number of species to ten species and one variety. Lodder & Kreger-van Rij (1952) placed two more species and one variety into synonymy with other species. On the basis of the authors' studies evidence will be presented in this paper that the number of species should be reduced still further to four species

Historical Development of the Nomenclature of the Apiculate Yeasts


Sporogenous forms
Asporogenous forms
Carpozyma
Engel, 1872
Saccharomyces apiculatus
Reess, 1870
Hansen, 1881, 1890
Saccharomyces apiculatus
4 to 6 spores,no shape noted
Beijerinck, 1898
Hansenia apiculata
Single-round-spored strains
Lindner, 1903, 1904
Hansenia apiculata
Zikes, 1911
Hanseniaspora
Lindner's round-spored strains
Zikes, 1911
Pseudosaccharomyces
Round-spored strains
Kufferath, 1928
Pseudosaccharomyces
Klöcker, 1912
Hanseniaspora
Hat-shaped spores
Klöcker, 1912
Pijper, 1928
Stelling-Dekker, 1931
Lodder, 1932
Kloeckeria
Janke, 1923
Kloeckeraspora
Round-spored strains
Niehaus, 1932
Kloeckera
Janke, 1928
Hanseniaspora
Species with round and
hat-shaped spores
Suggested by
Shehata *et al.*, 1955
Provisionally by Lodder
and Kreger-van Rij, 1952
in *Kloeckera*
Hanseniaspora
Includes all apiculate yeasts
Kudriavzev, 1954

and one variety. Some of these can be considered as the imperfect forms of known species of *Hanseniaspora*, whereas others have no known perfect stage. No explanation can be found in the literature regarding the origin of the imperfect species.

The paucity of knowledge of the life cycle of species belonging to *Hanseniaspora*, the nature of its relation to the imperfect genus *Kloeckera* and to the other two genera in the tribe *Nadsonieae*, stimulated a study to clarify these questions.

It was hoped to obtain additional knowledge on the properties and relationships between the various species and strains belonging to each of the four genera in question, by studying their abilities to ferment and assimilate various carbon compounds, their cell dimensions, and their vitamin requirements.

It will be shown that the perfect species of *Hanseniaspora* have a life cycle quite different from that of *Nadsonia* and of *Saccharomycodes*. Nutritionally, biochemically and morphologically the species of *Hanseniaspora* (and the imperfect genus *Kloeckera*) form a natural group.

Methods and Materials

List of Cultures. Taxonomic Designation	Number of strains	Source
Nadsonia fulvescens (NADSON et KONOKOTINA) SYDOW 1911	1	CBS
Nadsonia elongata KONOKOTINA 1913	3	CBS, van Niel
Saccharomycodes ludwigii HANSEN 1889	9	CBS, Kluyver, Carlsberg (includes 6 haploid strains)
Saccharomycodes bisporus CASTELLI 1942	2	CBS, Carlsberg
Hanseniaspora valbyensis LODDER 1932	7	CBS, various species of *Drosophila* from Mather and Davis, California
Hanseniaspora apuliensis CASTELLI 1948	1	CBS
Hanseniaspora uvarum (NIEHAUS) SHEHATA et al. 1932	11	CBS, various species of *Drosophila* from Mather and Davis, California
Hanseniaspora vineae VAN DER WALT et TSCHEUSCHNER 1957	1	CBS
Hanseniaspora osmophila (NIEHAUS) SHEHATA et al. 1932	6	CBS, various species of *Drosophila* and *Aulacigaster* from Mather, California
Kloeckera apiculata (REESS *emend.* KLÖCKER) JANKE 1870	21	CBS, various species of *Drosophila* from Mather, Porcupine Flat and Davis, California
Kloeckera magna (DE ROSSI) JANKE 1920	14	CBS, various species of *Drosophila* and *Aulacigaster* from Mather and Davis, California.

Kloeckera corticis (KLÖCKER) JANKE 1912	2	CBS, NRRL
Kloeckera antillarum (KLÖCKER) JANKE 1912	1	NRRL (from CBS)
Kloeckera javanica (KLÖCKER) JANKE 1912	1	NRRL (from CBS)
Kloeckera lafarii (KLÖCKER) JANKE 1912	1	NRRL (from CBS)
Kloeckera africana (KLÖCKER) JANKE 1912	2	NRRL, FT
Kloeckera jensenii (KLÖCKER) JANKE 1912	2	CBS, NRRL

CBS = Centraal bureau voor Schimmelcultures, Yeast Division, Delft, Netherlands.
Carlsberg Laboratory, Copenhagen, Denmark.
FT = Department of Food Technology, University of California, Davis, California.
NRRL = Northern Regional Research Laboratory, USDA, Peoria, Illinois.

Nuclear Staining. Nuclear staining was done by a slight modification of the method of CASSEL (1950). Cells were suspended in 0.05 % gelatin to prevent clumping during drying. After the cell suspension on the slide was allowed to dry, the cells were fixed in Schaudinn's fixative solution for 20 minutes, rinsed with distilled water, immersed in 1 N perchloric acid, and stored at 4° C for 72 to 84 hours. The preparations were then washed with distilled water and stained with an aqueous solution of Azure A [1]) (0.1 %) for 45 to 60 seconds. Nuclei appeared dark blue and the cells light blue to colorless.

X-ray Survival. The method employed for determining the degree of ploidy in the apiculate yeasts was essentially that of BEAM *et al.* (1954). The source of X-rays was a low voltage beryllium-window X-ray tube operated at 50 kv and 25 ma. The dose rate was 252 roent/sec under these conditions with the material to be irradiated 16 cm from the tube target.

Carbon Assimilation. Four methods of determining the assimilation of the various carbon compounds by the apiculate yeasts were used. These were the classical auxanogram, a replica plating method adapted for yeasts by SHIFRINE *et al.* (1954), a multipoint replication method of BEECH *et al.* (1955) and the liquid media technique according to WICKERHAM (1951). Yeast Nitrogen Base (Difco) was used as the basal medium and 2 % washed agar was added when needed.

The following 34 compounds were used: D-glucose, D-galactose, L-sorbose, maltose, sucrose, cellobiose, trehalose, lactose, melibiose, raffinose, melezitose, inulin, soluble starch, D-xylose, L-arabinose, D-arabinose, D-ribose, L-rhamnose, ethanol (in liquid medium only), glycerol, i-erythritol, adonitol, dulcitol, D-mannitol, D-sorbitol, alpha-methyl-D-glucoside, salicin, glucono-delta-lactone, calcium-2-keto-D-gluconate, potassium-5-keto-D-gluconate, DL-lactic acid, succinic acid, citric acid and i-inositol.

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[1]) National Aniline Division, Allied Chemical and Dye Corp., New York. Certification No. NAz15

The various compounds were added (10 to 15 mg per spot) to the surface of plates in the classical auxanogram. In the other methods, sterile solutions of the various carbon compounds were added to the basal medium so the final concentration of the carbon source was 0.5 %. The solutions were prepared in tenfold concentrations and sterilized either by Seitz filtration or by autoclaving.

Fermentation. The ability to ferment various sugars was determined in Durham tubes, and, in certain cases, in van Iterson-Kluyver fermentometers. The sugars used were glucose, galactose, sucrose, maltose, lactose (two per cent each) and raffinose (four per cent). Cellobiose was tested with certain strains. The basal medium was 10 % (v/v) yeast autolysate prepared according to the procedure of BOUTHILET *et al.* (1949). Yeast Extract (Difco) was less satisfactory for the apiculate yeasts.

Vitamin Requirements. The need for an exogenous source of certain vitamins was studied by the method of WICKERHAM (1951) modified so that the effect of the omission of single vitamins could be determined. The basal medium was Bacto Vitamin-free Yeast Base. The control was Bacto Yeast Nitrogen Base plus 1 per cent glucose. The nine vitamins were used in the same concentrations as incorporated in the Yeast Nitrogen Base. Periodic observations for growth were measured visually according to the system used by WICKERHAM (1951). After 14 days, the turbidity of the media was measured in a Klett-Summerson colorimeter (Filter No. 54).

Results

Life Cycle of Hanseniaspora

Vegetative Reproduction. KLÖCKER (1912, 1913), NIEHAUS (1932), CASTELLI (1935), and DVORNIK (1938) are among the principal investigators who have studied this group of apiculate yeasts. These workers have described, in more or less detail, the process of vegetative reproduction in these microorganisms. While they are in general agreement as to the manner of budding, no detailed illustrations of the sequence of events have been made. It is felt that this process should be clarified and the ontogeny should be followed in detail. The development of a cell of *H. valbyensis* in a hanging drop culture is illustrated by camera lucida drawings in Fig. 1. Budding in these yeasts takes place only at the two extremities of the cell. Buds are restricted at their place of origin to a small area at the tips of the cell. They are formed on a fairly broad base. Cells of *H. uvarum* and *K. apiculata* reproduce vegetatively in the same manner as those of *H. valbyensis*.

The behavior of the nucleus was followed during vegetative reproduction. The vegetative cell is uninucleate. Stained preparations show a small, compact, deeply stained body which is generally located in the middle of the cell adjacent to the vacuole. No apparent change is observable until the bud is between one-quarter and one-half the size of the mother cell. During this time, the nucleus migrates towards the site of budding. At the time the nucleus divides it is located near the constriction between the mother cell and the bud. Shortly after nuclear division is completed the daughter cell is separated and the process of budding is repeated.

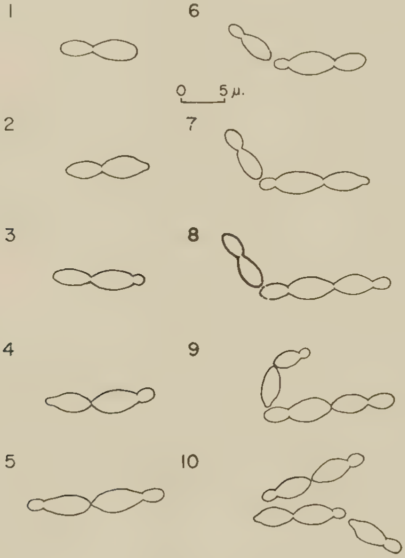

Fig. 1. The process of vegetative reproduction in *Hanseniaspora*. Drawings made at 0, 30, 60, 85, 105, 125, 135, 145, 165 and 180 minutes showing the development of a vegetative cell from the bud stage to a separate cell in yeast autolysate-glucose medium at *ca.* 22°C.

Ploidy of the Vegetative Cells. The ploidy of the vegetative cells of *H. valbyensis* was determined by means of X-ray survival curves. The survival curve shown in Fig. 2 represents the averages of 6 replicates at each dose of X-radiation. Irradiated media, using the highest dose of X-rays used in each experiment, were found not to have a toxic effect on the growth of the yeasts. The curve is of the multi-hit type. Extrapolation of the linear portion of the curve to zero dose X-ray gave an intercept very close to 200, indicating the diploid nature of the vegetative cells. The LD_{50} for the culture is 25,200 roentgens. For a comparison of values, Beam *et al.* (1954) reported the LD_{50} of *Saccharomyces cerevisiae* to be 22,000 roentgens.

The X-ray survival curve of cells of *H. uvarum* is shown in Fig. 3. It is quite similar to the curve obtained for *H. valbyensis*. The intercept of the extrapolated curve is very close to 200 which is indicative of the diploid nature of the vegetative cells. The LD_{50} for the culture is 27,700 roentgens.

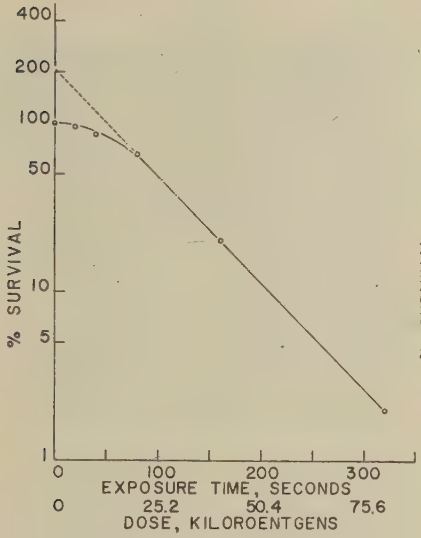

Fig. 2. X-ray survival curve of *Hanseniaspora valbyensis*.

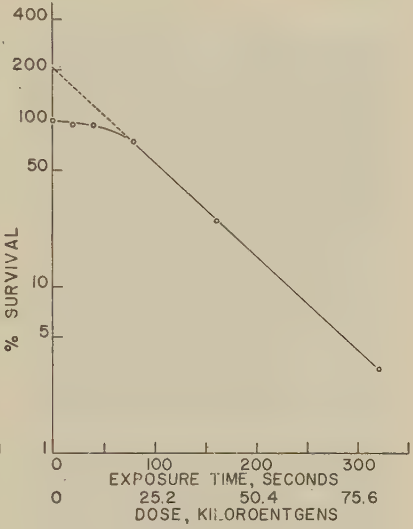

Fig. 3. X-ray survival curve of *Hanseniaspora uvarum*.

Sexual reproduction. The formation and the subsequent germination of the ascospores was studied next. Species forming hat-shaped spores and those forming round spores will be discussed separately.

A. Species forming hat-shaped spores.

Stained preparations of 18 hour old cells of *H. valbyensis* on malt agar reveal cells which contain two or four nuclei, suggesting that reduction division has taken place. (See Fig. 4a, b, and c.).

All of the culture of *H. valbyensis* sporulated readily on malt agar after 24 to 36 hours and produced an abundance of asci and spores. The overwhelming majority of the asci contained 4 spores per ascus although a few asci containing only 2 or 3 spores were observed. The spores are hat- to helmet-shaped and contain a small refractile body. They are approximately 1.5 μ in diameter. The helmet or hat shape is evident as soon as the spores are distinguishable in the ascus. Only after the spores swell in the early stages of germination do they assume a roundish appearance. Even at this time the "brim" is still discernable (see Fig. 4d). Asci rupture as soon as the spores are mature. Liberated spores can be observed in the medium in 24 hours. These spores tend to clump together and hence large masses of spores can be observed in cultures 3 to

4 days old. The spores are easily stained by the method of Bouthilet (PHAFF & MRAK, 1948).

KLÖCKER (1912) briefly stated that he had observed spore germination in *H. valbyensis* but he gave no details of the process.

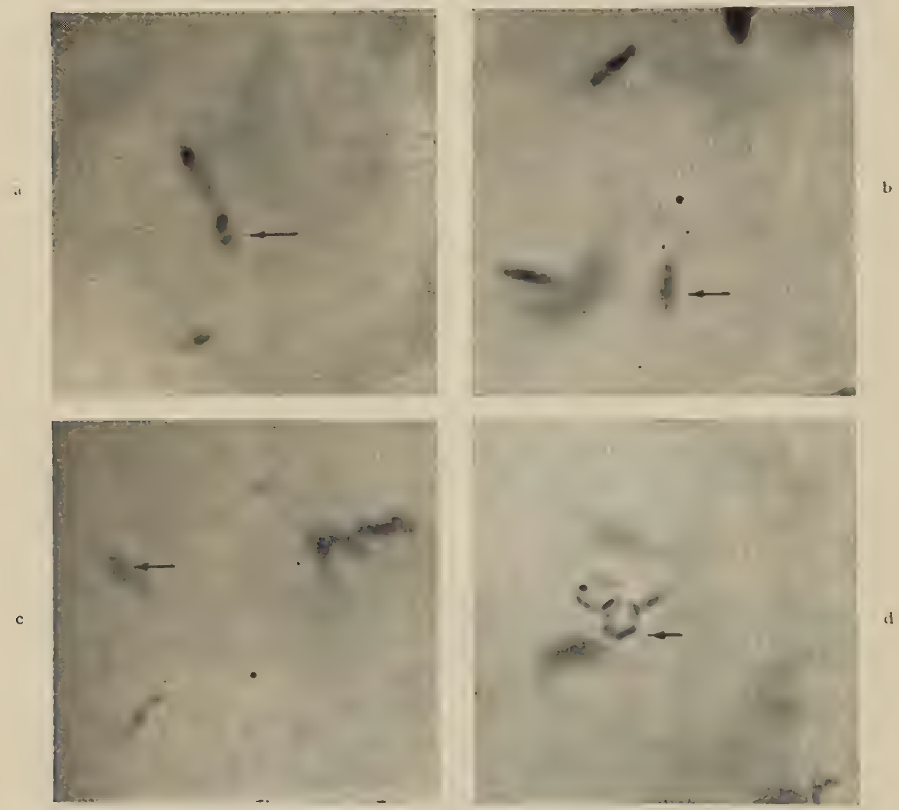

Fig. 4. Nuclear stains and germinating spores of *Hanseniaspora valbyensis*.

a. Cell with 3 nuclei. The lower nucleus has completed division. The upper nucleus is in the process of dividing.
b. Cell with completed reduction division.
c. Nuclei in ascospores showing typical ,,cap''-shape of the nucleus when in the spore.
d. Two germinating ascospores. Note the clearly defined ,,brim'' of the hat-shaped spores.

Ten asci (5 each from two different strains) were microdissected and the individual spores (4 from each ascus) placed on a solid medium containing yeast autolysate (10 % v/v) plus 2 % glucose. All of the isolated spores germinated. The resulting colonies were approximately 0.5 mm in diameter after 24 hours. Microscopic examination after 60 hours revealed asci and spores in each of the single spore cultures. The strains of *H. valbyensis* examined were, therefore, homothallic.

Direct observation of isolated spores in hanging drop cultures (yeast autolysate-glucose) showed the sequence of events which took place during germination and subsequent budding. Camera lucida drawings of a group of 3 spores during germination are illustrated in fig. 5.

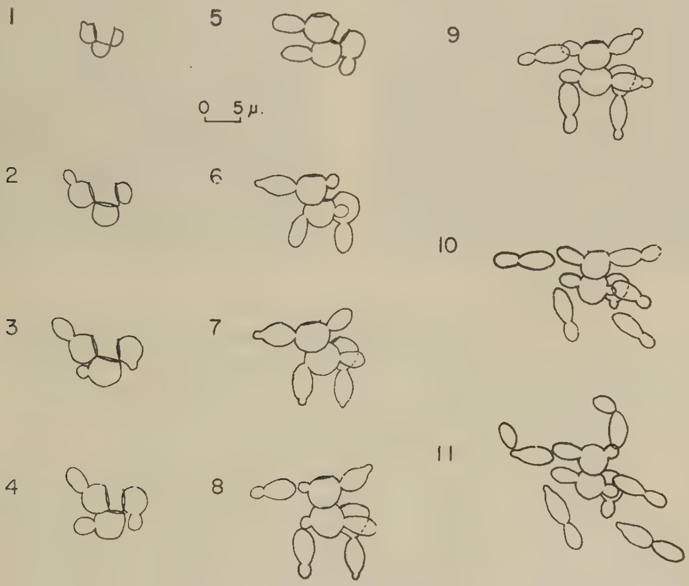

Fig. 5. Sequence of events in the spore germination of *Hanseniaspora valbyensis*. Drawings made at 0, 25, 70, 100, 130, 155, 180, 195, 205, 225, and 245 minutes showing the germination of three hat-shaped ascopores and the development of the vegetative cells arising from them in yeast autolysate-glucose medium at *ca.* 22°C.

Conjugation between two ascospores or between buds derived from the spores was never observed. Diploidization apparently takes place within the germinating ascospores prior to bud formation. This might occur by mitotic division of the haploid spore nucleus and subsequent karyogamy to form the diploid condition. In the vast majority of the stained preparations the germinating spore appears to be uninucleate (Fig. 6a). However, some preparations showed spores in the early stage of germination in which 2 nuclei were present. These were discrete entities loated close together in the middle of the spore (Fig. 6b). This is regarded as indicative of the possible method of diploidization mentioned above, because in vegetative reproduction the dividing nucleus is always located near the point of budding, not in the middle of the cell. WINGE & ROBERTS (1949) demonstrated that this method of diploidization takes place in *Saccharomyces chevalieri* and showed that this yeast has a gene *D* which is responsible for obligatory diploidization of germinating single spore cultures.

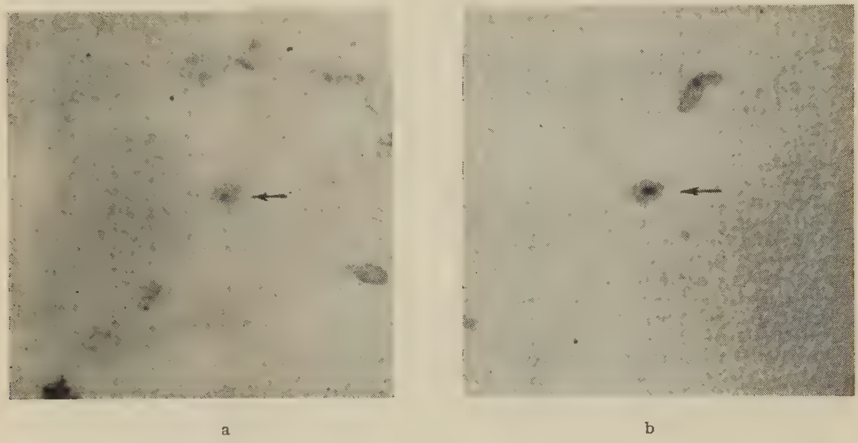
a
b

Fig. 6. Nuclear stains of ascospores of *Hanseniaspora valbyensis* in the early stages of germination.

a. Nuclear stain showing the uninucleate condition usually observed in germinating spores.
b. Germinating spore showing two centrally located nuclei.

B. Species forming Spherical Spores.

The taxonomic position of *H. uvarum* and of *H. osmophila* is still unsettled. LODDER & KREGER-VAN RIJ (1952) placed them provisionally in the imperfect genus *Kloeckera* pending clarification of the ability of these yeasts to form true ascospores. It was felt desirable, therefore, to settle the controversial nature of the spherical bodies formed by some of the apiculate yeasts by giving conclusive proof of their ability to germinate and to study the nuclear behaviour during their formation and germination.

In *H. uvarum* four nuclei can be observed when cells of a 4 to 5 day-old culture on potato-dextrose-agar (PDA) are stained. Very few cells were observed in this condition. In one case a binucleate cell was observed. The low percentage of asci formed by the culture may account for the scarcity of cells showing reduction division. In *H. uvarum* and in *H. osmophila,* where generally only one spore is formed per ascus, the extra nuclei apparently degenerate as the spores are uninucleate. The changes that the nucleus undergoes during sporulation is shown in Fig. 7a, b.

Spores were formed best and most abundantly on PDA. Commercially available PDA (Difco) did not induce sporulation nearly as well as PDA prepared from a potato extract according to the procedure of LODDER & KREGER-VAN RIJ (1952). The best procedure to induce sporulation was as follows: A culture is streaked on a PDA-covered microscope slide in two parallel lines and a sterile coverslip is placed on a portion of the streak. Upon examination of the preparation after 7 days the asci and spores appear generally in localized areas just inside the area covered by the coverslip.

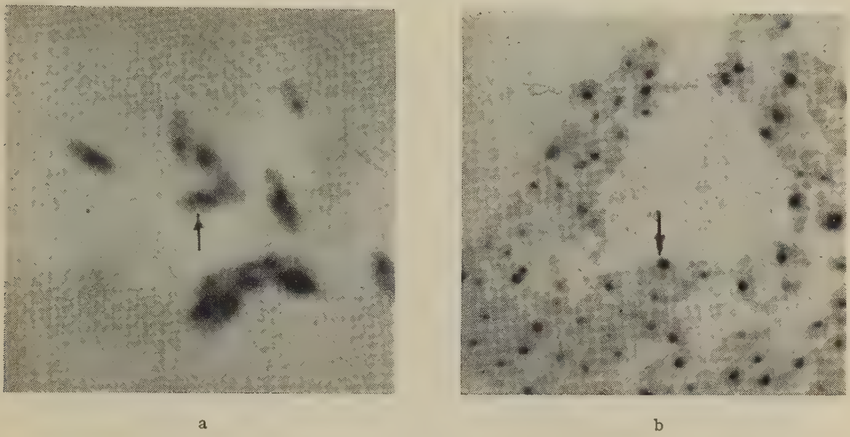

Fig. 7. Nuclear stains of *Hanseniaspora uvarum*.
a. Cell in which meiosis is complete showing four nuclei.
b. Ascus with uninucleate spore.

These areas frequently contain practically nothing but asci (see Fig. 8). Only a small number of asci are found in the aerobic portion of the streak and also in the portion farther in from the edge of the coverslip.

Cultures of *H. uvarum* and of *H. osmophila* generally do not form such an abundance of asci and spores as does *H. valbyensis*. Freshly isolated strains may produce up to 20 % asci and rarely more. The number of asci in a wet mount preparation depends greatly upon the exact location on the sporulation medium from which the sample is taken. This has been illustrated above. More commonly the proportion of asci is 5 % or less. The percentage of asci formed drops appreciably upon continued laboratory cultivation. Some strains appear to lose the ability to sporulate completely in a relatively short period of time, whereas other strains have retained this ability fairly well for a period of six years.

The asci contain usually one and rarely two round spores. The spores are 3.0 to 3.5 μ in diameter and contain a small refractile granule (see Fig. 8). Generally, asci do not rupture until the spore swells prior to germination, although occasionally spores are observed free in the medium. The spores are easily stained by malachite green (PHAFF & MRAK, 1948).

RÖHLING (1905) reported the successful germination of a single round spore and stated that germination took place by budding. NIEHAUS (1932) claimed that germination took place by a germ tube. DVORNIK (1938) also stated that he was able to germinate these ascospores and claimed that the process took place by budding

In the experience of other investigators spores were unable to germinate and, in fact, some did not believe them to be spores. (KLÖCKER, 1915; CASTELLI, 1935).

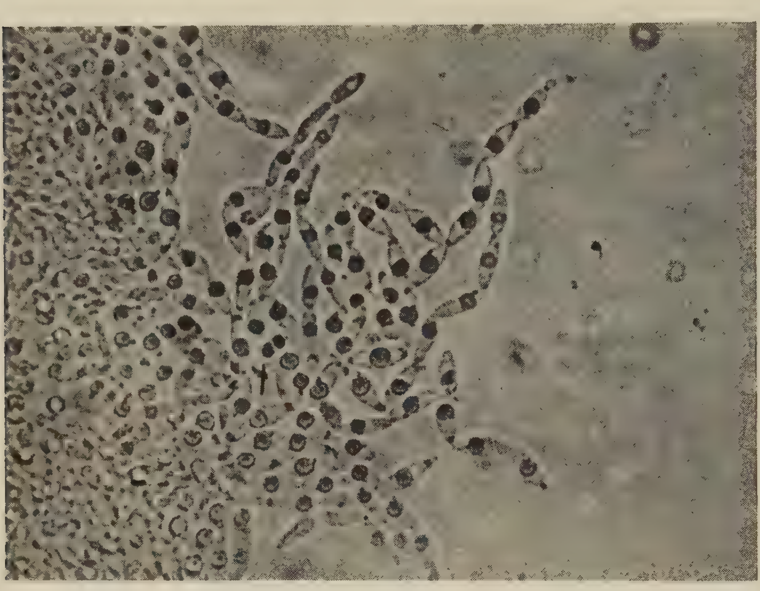

Fig. 8. Spore formation on potato-dextrose agar by *Hanseniaspora uvarum*. Photograph of a localized area composed of practically all asci and spores. One ascus contains two spores.

In this study proof of spore germination was obtained by two techniques. First, by the isolation of single spores by micromanipulation and examination of the resulting colonies on solid medium. In addition, several intact asci of *H. uvarum*, containing single spores, were isolated, placed on solid medium and allowed to germinate. Second, the details of the germination process were followed by direct observation of the germination of isolated spores and intact asci in hanging drop cultures. Finally, the behaviour of the nucleus during spore germination was followed in stained preparations.

Fourteen single-spored asci were micro-dissected and the spores placed on yeast autolysate-glucose-agar. Five intact asci, each containing a single spore, were also placed on the same medium. All spores germinated and had formed colonies from 0.25 to 0.5 mm in diameter after 24 hours. Subcultures of the single spore colonies were made on malt agar and on PDA slides. All contained spores after 7 days on both media. It had been hoped that these cultures would contain a higher percentage of sporulating cells than the parent culture. However, all of the single spore cultures sporulated to the same degree as the original parent culture (3 to 5 % in an average wet mount).

The various stages of germination and subsequent budding observed in hanging drop cultures of a single spore are illustrated in Fig. 9 and 10. The details of the germination are very similar to those of *H. valbyensis*. There was no evidence of conjugation between buds or the resulting vegetative cells. The cells arising from spore buds develop to a size comparable to the vegetative cells of the parent culture.

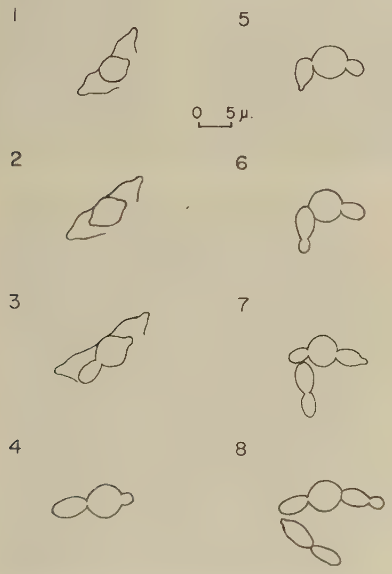

Fig. 9. Sequence of events in the spore germination of *Hanseniaspora uvarum*. Drawins made at 0, 30, 75, 105, 135, 165, 190 and 205 minutes showing the germination of a spherical spore in yeast autolysate-glucose medium at *ca*. 22° C. The germinating spore moved free of the ascus remnants between 75 and 105 minutes and between 105 and 135 minutes the germinating spore turned *ca*. 90° on its axis.

Diploidization apparently takes place in *H. uvarum* in the same manner as that postulated for *H. valbyensis*, *i. e.* in the germinating ascospore prior to bud formation. In stained preparations practically all of the germinating spores appeared to be uninucleate. One germinating spore was observed which contained two distinct nuclei. The spore had just started to form a "bud primordium". The time lapse between the spore nucleus dividing mitotically and subsequent karyogamy to form the diploid condition must be very brief.

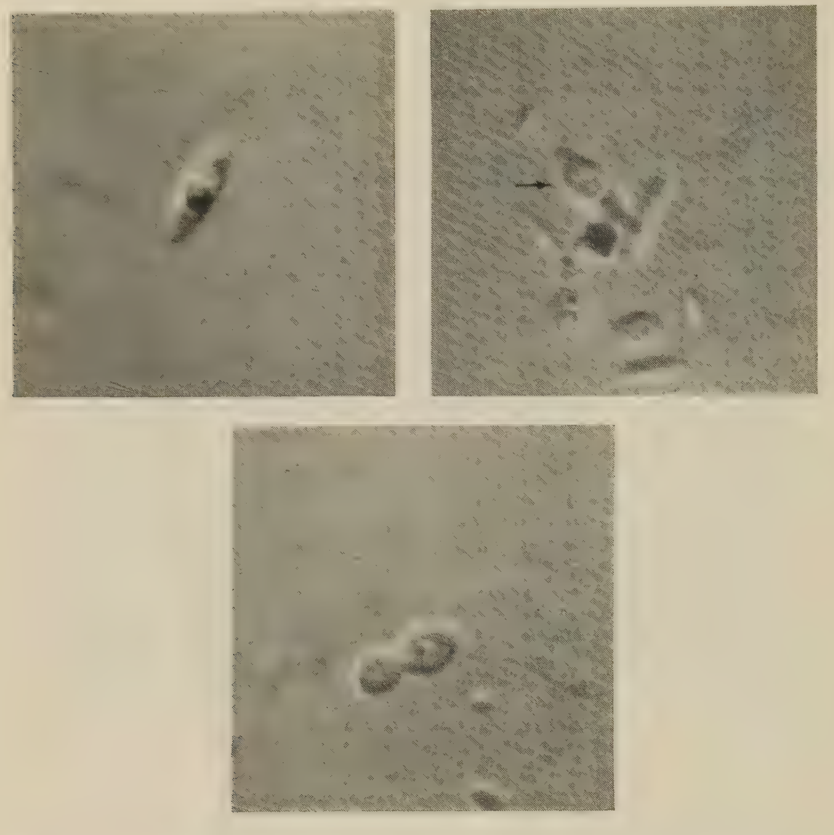

Fig. 10. Photographs of the germination of a spore of *Hanseniaspora uvarum* by a budding process in yeast autolysate-glucose medium.

The Possible Origin of Asporogenous Forms

The disclosure of the homothallic nature of *H. valbyensis* and of *H. uvarum* and the diploidization apparently occurring within the germinating ascospore raised the problem of explaining by what means, other than heterothallism, asporogenous strains might originate from the sporogenous cultures.

As will be shown later, *H. valbyensis*, *H. uvarum* and *Kloeckera apiculata* have identical physiological and morphological characteristics. It may then be assumed that *K. apiculata* is the imperfect form of both *H. valbyensis* and *H. uvarum*. The imperfect form is isolated frequently from natural sources either alone or in association with *H. valbyensis* and or *H. uvarum*. All attempts to induce sporulation in such isolates were fruitless. An authentic strain of *H. uvarum*, which was originally isolated by NIEHAUS (1932) was also studied. According to LODDER & KREGER-VAN RIJ (1952) this yeast had lost the ability to form spores with which the authors concur. If this yeast were reidentified without knowledge of its origin, it would be classified as *K. apiculata*.

A possible source of *K. apiculata* might be a fraction of permanently asporogenous cells in cultures of one or both of the two perfect species, which under certain conditions might outgrow the potentially sporogenous cells. A case in fact has been demonstrated by LEUPOLD (1950). In clones of the haploid yeast *Schizosaccharomyces pombe*, he found homothallic cells, heterothallic cells and a sterile type which was incapable of forming spores.

To determine if asporogenous clones arising from single cells could be detected in *H. valbyensis* and in *H. uvarum*, cultures were plated on malt agar and a large number of individual colonies were checked for their ability to sporulate. Since the strain of *H. valbyensis* used in this study formed many spores, and the percentage of asporogenous cells, if present, might be very small, cells of two different ages were used for plating (six hours and 50 days). It was reasoned that in an old culture, asporogenous cells might be more abundant than in a vigorously growing young culture. In the case of *H. uvarum*, which sporulated poorly, only cells, six hours old, were used.

Two hundred and fifty randomly selected colonies arising from the population of a young culture of *H. valbyensis* and 210 colonies from an aged culture were all found to be sporogenous when examined after 5 days on malt agar. The percentage of sporogenous cells in these colonies was similar to that found in the parent culture.

When examined after 7 days, 162 randomly selected colonies of *H. uvarum* were all found to be sporogenous. The number of spores present in the colonies was low but of the same order of magnitude as that in the parent culture. Transfers of some of these colonies to PDA slides were also made. All showed the localized, highly sporogenous areas just inside the area covered by the coverslip in the same manner as the parent culture.

Thus no permanently asexual cells originated the randomly selected clones of these organisms. However, the possibility of an occasional asporogenous mutant arising is not ruled out. If the frequency of such a mutation occuring is very low the number of clones examined may have been insufficiently large to detect a mutant asporogenous clone.

A determination of the degree of ploidy was made of *K. apiculata* and of the asporogenous strain of *H. uvarum* (originally isolated by NIEHAUS) for comparison with the results obtained with *H. valbyensis* and the sporogenous culture of *H. uvarum*.

The asporogenous culture of *H. uvarum*, when irradiated, resulted in a multi-hit type of curve very similar to those which were obtained with *H. valbyensis* and the sporogenous strain of *H. uvarum* (see Fig. 11). The intercept of the extrapolated curve was very near 200 at zero X-ray dose. The LD_{50} for the culture was 25,200 roentgens.

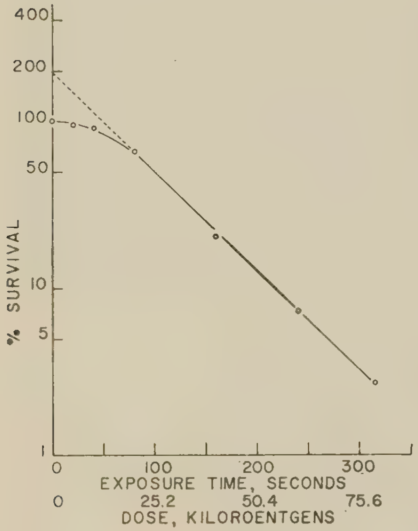

Fig. 11. X-ray survival curve of an asporogenous strain of *Hanseniaspora uvarum.*

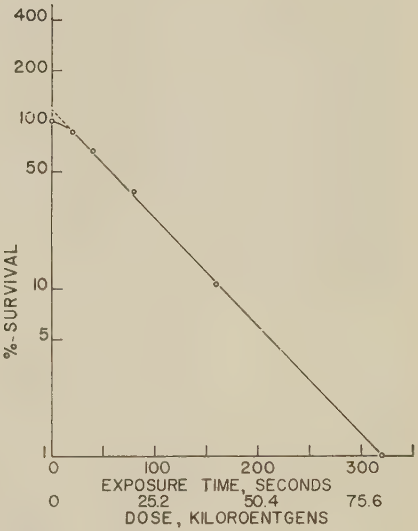

Fig. 12. X-ray survival curve of *Kloeckera apiculata.*

The culture of *K. apiculata*, when subjected to X-radiation, gave a survival curve similar to a single-hit type of curve, which is indicative of a haploid condition (see Fig. 12). The extrapolate of the linear portion of the curve intercepted near 100 at zero X-ray dose. The LD_{50} of the culture was 14,350. This was only 52 to 57 % of the corresponding dose for the other three cultures.

Carbon Assimilation Patterns

Tests to determine the assimilation of various carbon sources by microorganisms have been used for many years. It was probably first applied to yeasts by BEIJERINCK (1889). LODDER (1934) was the first to use the auxanographic technique in her classification studies of certain imperfect yeasts. LODDER & KREGER-VAN RIJ (1952) expanded the use of the auxanographic technique to the separation of all sporogenous and asporogenous species.

The results obtained with 101 strains of yeasts representing the species of *Nadsonia, Saccharomycodes, Hanseniaspora* and *Kloeckera* are shown in Table I. The species of *Hanseniaspora* and *Kloeckera,* on the basis of their carbon assimilation patterns, fall into three main groups, with the exception of *K. africana. H. valbyensis, H. uvarum,* and *K. apiculata* form one group. Members of this group are able to assimilate 5 carbon compounds: glucose, cel-

TABLE 1

Assimilation of various carbon sources by the apiculate yeasts

	No. cultures tested	Glucose	Cellobiose	Salicin	Glucono-δ-lactone	Ca-2-keto-D-gluconate	Maltose	Sucrose	Raffinose	Glycerol	Trehalose	DL Lactic acid
H. valbyensis	8	+1)	+	+	+	+	—	—	—	—	—	—
H. uvarum	29	+	+	+	+	+	—	—	—	—	—	—
H. osmophila	6	+	+	+	+	+	+	—	—	—	—	—
K. apiculata	22	+	+	+	+	+	—	—	—	—	—	—
K. magna	14	+	+	+	+	+	+	—	—	—	—	—
K. corticis	2	+	+	+	+	+	+	—	—	—	—	—
K. africana	2	+	+	+	+	+	+	+W	—	—	+	—
K. lafarii	1	+	+	+	+	+	—	+	—	+	—	—
K. antillarum	1	+	+	+	+	+	—	+	WL	+	—	—
K. javanica	1	+	+	+	+	+	—	+	WL	+	—	—
K. jensenii	2	+	+	+	+	+	—	+	WL	+	—	—
S. Ludwigii	9	+	+	+	—	—	—	+	+	+	—	+
N. elongata 2)	3	+	—	—	+	—	—	—	—	+	—	+L
N. fulvescens 3)	1	+	—	—	+	—	+	+	—	+	—	+

1) The ability of a yeast to assimilate a carbon compound is desgnated (+) and the inability to utilize a carbon compound is designated (—); L designates latent; W designates weak.

2) *N. elongata* also assimilates L-sorbose (latently), ethanol, D-sorbitol and succinic acid.

3) *N. fulvescens* also assimilates L-sorbose (latently), ethanol, D-sorbitol, succinic acid, galactose, L-arabinose, adonitol, D-mannitol and alpha-methyl-D-glucoside.

lobiose, salicin, glucono-delta-lactone, and Ca-2-keto-D-gluconate. *H. osmophila*, *K. magna* and *K. corticis* form a second group. Species in this group assimilate maltose in addition to the 5 compounds assimilated by the first group. The third group is composed of *K. antillarum*, *K. javanica*, *K. jensenii* and *K. lafarii*. Sucrose and glycerol are assimilated in addition to the 5 compounds characterizing the assimilation pattern of the first group. All members of the third group, except *K. lafarii*, are also capable of assimilating raffinose weakly and latently. Variable results were obtained, however, when this sugar was tested by the various methods used. In addition the results varied with the amount of inoculum used. With the auxanographic or replica methods, raffinose assimilation is generally negative. In liquid medium the results are also negative if the customary light inoculum is used, but latently positive with a heavier inoculation. The difficulty found in determining whether or not this compound is assimilated makes it of dubious taxonomic value in specific differentiation.

K. africana differs in its assimilation pattern from the three main groups. It assimilates the 5 compounds common to all three groups and, in addition, sucrose, maltose and trehalose.

S. ludwigii differs from the species of *Hanseniaspora* and *Kloeckera* in its ability to utilize lactic acid and its inability to assimilate gluconate or 2-ketogluconate. The two species of *Nadsonia* can utilize a larger number of compounds.

The absence of strain variation shows the homogeneity of the different species.

Fermentation

The property to ferment sugars with the formation of ethanol and carbon dioxide is one of the oldest physiological properties used in yeast taxonomy. The fermentation of specific sugars is one of the main characters used for species differentiation.

TABLE II.

Fermentation of various sugars by apiculate yeasts

	No. of cultures tested	Glucose	Galactose	Sucrose	Maltose	Lactose	Raffinose
Hanseniaspora valbyensis	7	3+ 1)	—	—	—	—	—
H. uvarum	28	3+	—	—	—	—	—
H. osmophila	6	3+	—	—	—	—	—
Kloeckera apiculata	22	3+	—	—	—	—	—
K. magna	14	3+	—	—	—	—	—
K. corticis	2	3+	—	—	— 2)	—	—
K. africana	2	3+	—	—	—	—	—
K. antillarum	1	3+	—	3+	—	—	VW 3)
K. javanica	1	3+	—	2+	—	—	VW 3)
K. jensenii	2	3+	—	2+	—	—	VW 3)
K. lafarii	1	3+	—	2+	—	—	—
Saccharomycodes ludwigii	9	3+	—	2+	—	—	+1/3 4)
Nadsonia elongata	3	3+	—	—	—	—	—
N. fulvescens	1	3+	2+	3+	+W 5)	—	—

1) 3+ indicates a full vial of gas in 24 hours, at room temperature;
2+ a full vial in 48 to 72 hours;
1+ a full tube after 5 days.

2) LODDER & KREGER VAN RIJ (1952) record fermentation as weak or negative.

3) LODDER & KREGER-VAN RIJ (1952) record the fermentation as +1/3.

4) +1/3 only the fructose portion of the raffinose molecule is fermented.

5) +W indicates a weak fermentation.

The ability to ferment glucose, galactose, sucrose, maltose, lactose and raffinose was determined for 99 strains. The results are summarized in Table II.

It will be noted that the fermentation of raffinose by *K. antillarum* *K. javanica* and *K. jensenii* is recorded as very weak. LODDER &

KREGER-VAN RIJ (1952) make no mention of such a weak fermentative ability towards raffinose. Results obtained with these yeasts were negative when the fermentation tests were done in Durham tubes, even if the fermentation tubes were observed for 32 days at room temperature. When tested in a van Iterson-Kluyver fermentometer, using a heavy inoculum, no gas was formed until 8 to 10 days after inoculation. From this time on the fermentation of raffinose proceeded slowly until approximately one-third of the raffinose molecule was fermented. The time necessary for this to take place was approximately 40 days for *K. jensenii* and 84 days for *K. antillarum* and for *K. javanica.* Normally the fermentation or raffinose is complete in 2 to 3 days.

The long lag period before fermentation started suggested the possibility that permeability of the cell membrane to raffinose might be responsible. Cells were frozen in liquid nitrogen and then thawed prior to placing them in the van Iterson-Kluyver fermentometer. Gas production was observable after 24 hours. The rate of fermentation, however, was still quite slow. Glucose fermentation by similarly treated cells started in 5 hours and was complete in 48 to 72 hours. Untreated cells complete the fermentation of glucose in a similar period of time.

Since all strains of the species of *Hanseniaspora valbyensis, H. uvarum* and *K. apiculata* assimilate cellobiose as strongly as glucose, 27 strains were tested for the fermentation of this sugar. The results ranged from no fermentation in 19 days to full vials of gas in 5 days. The results varied with different strains of the same species. Consequently this property is without value for specific differentation in this group. *K. africana,* although able to assimilate trehalose, cannot ferment this sugar.

One strain which was described by CASTELLI (1948) as *H. apuliensis* was found to be the same as *H. valbyensis.* The assimilation and fermentation of galactose, which Castelli found to be positive, could not be confirmed. Similarly, *H. vineae* was identified with *H. osmophila.*

Vitamin Requirements

Differences in vitamin requirements have been restricted almost entirely to strain differentiation within a species. Practically all of this work has been done with strains of *Saccharomyces cerevisiae* and *S. carlsbergensis* (see e.g. SCHULTZ & ATKIN, 1947).

The Dutch group of yeast taxonomists have not used vitamin requirements as a taxonomic tool. WICKERHAM (1951) determined the ability of species of *Hansenula* to grow in a vitamin-free medium, but he did not determine specific vitamin requirements. He has given phylogenetic interpretations of his results in the evolutionary development of species of *Hansenula.*

The vitamin requirements of the various members of the tribe *Nadsonieae* and of the genus *Kloeckera* were determined to obtain

TABLE III

Growth responses of apiculate yeasts in media deficient in particular vitamins

	No. strains tested	Less Thiamin	Less niacin	Less Ca-pantothenate	Less pyridoxine	Less biotin	Less inositol	Less thiamin and pyridoxine	Plus six vitamins	Vitamin-free	Nitrogen base plus glucose
H. valbyensis	2	—1)	—	—	—	—	—	—	+2)	—	+3)
H. uvarum	6	—	—	—	—	—	—	—	+	—	+
H. osmophila	4	—	—	—	—	—	—	—	+	—	+
K. apiculata	5	—	—	—	—	—	—	—	+	—	+
K. magna	2	—	—	—	—	—	—	—	+	—	+
K. corticis	2	—	—	—	—	—	—	—	+	—	+
K. africana	2	—	—	—	—	—	—	—	+	—	+
K. antillarum	1	—	—	—	—	—	—	—	+	—	+
K. javanica	1	—	—	—	—	—	—	—	+	—	+
K. jensenii	2	—	—	—	—	—	—	—	+	—	+
K. lafarii	1	—	—	—	—	—	—	—	+	—	+
S. ludwigii	4	+	—	—	—	—	+	—	+	—	+
N. elongata	3	+	+	+	+	+	+	+	+	+	+
N. fulvescens	1	+	+	+	—	—	+	+	+	—	+

1) — = No or slight growth in 4 days. Required omitted vitamin(s).

2) + = Good growth in 4 days. No requirement for omitted vitamin(s).

3) = Complete medium contains nine vitamins.

additional information on the relationship between the different genera and to determine the variation in vitamin requirements between strains and species of a particular genus.

Table III summarizes the results of studies on the vitamin requirements of 28 strains of apiculate yeasts (representing 3 sporogenous and 8 asporogenous species), 4 strains of *Saccharomycodes ludwigii*, 3 strains of *Nadsonia elongata* and 1 strain of *N. fulvescens*.

The results demonstrate that not only all strains of a species have the same vitamin requirements, but all species of *Hanseniaspora* and *Kloeckera* show identical qualitative responses to vitamin omissions Since it was found that none of the species required para-aminobenzoic acid, folic acid or riboflavin, these vitamins have been omitted from the table.

Fig. 13 summarizes the relative amounts of growth in media lacking required vitamins for *all* 28 strains of *Hanseniaspora* and *Kloeckera* tested. The relative amounts of growth are based on nitrogen base plus glucose equalling 100 and vitamin free medium as zero. This bar graph shows that the initial tubes of some strains equalled or exceeded, the nitrogen base control. However, upon transferring into second tubes of the same medium, the amount of growth was very greatly reduced. The absolute requirements for inositol and Ca-pantothenate are strikingly shown in this bar graph. Although the other four vitamins appear to be relative requirements, their simultaneous omission resulted in the absence of growth in the second tube.

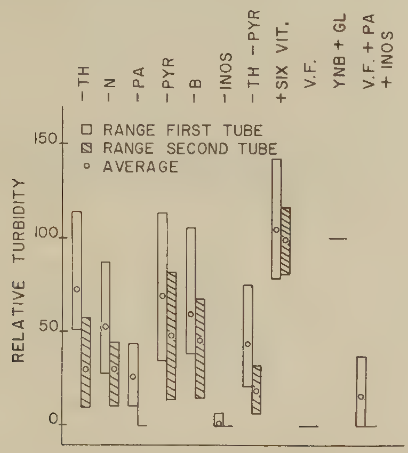

Fig. 13. Relative ranges of growth in vitamin deficient media of 28 strains of apiculate yeasts, representing 3 species of *Hanseniaspora* and 8 species of *Kloeckera*, after 14 days incubation at *ca.* 22° C.
Th = thiamin, N = niacin, PA = Ca-pantothenate, PYR = pyridoxine, B = biotin, INOS = inositol, VF = yeast vitamin-free medium (Difco), YNB+GLUC= yeast nitrogen base (Difco) plus glucose.

The 3 strains of *Nadsonia elongata* all grew well in the vitamin free medium. *N. fulvescens*, on the other hand, required both biotin and pyridoxine for growth.

The 4 strains of *Saccharomycodes ludwigii* required an exogenous source of niacin, Ca-pantothenate, biotin and pyridoxine, for maximal growth.

Cell size

The range of cell dimensions has been and still is used for species differentiation. In general, however, the taxonomic value placed on this character has lessened as more knowledge was gained on the variations existing between strains of a given species. Many species previously separated on the basis of differences in cell size (see *e.g.* LODDER, 1934) have been either combined in synonymy with, or reduced to varieties of a particular species by LODDER & KREGER-VAN RIJ (1952).

Since the two species *Kloeckera magna* and *K. corticis* and the three species *K. antillarum*, *K. javanica* and *K. jensenii* are still separated on the basis of cell dimensions, the range of cell sizes of the apiculate yeasts was determined.

The measurement of the cells of apiculate yeasts presents a problem not encountered in other yeasts. This problem is one of determining whether or not the cell being measured is in the process of forming a bud. The apiculate yeast elongates at the poles prior to constriction of the bud making it impossible to differentiate between a cell in the early stages of budding and a non-budding cell having an elongate shape. Only cells which were not constricted between the "bud" and cell were measured. Cells which did not appear healthy and vigorous and "involution" forms were disregarded.

Cell measurements of species of *Hanseniaspora* and *Kloeckera* are summarized in Table IV. Determinations given by LODDER & KREGER-VAN RIJ (1952), and in some cases those of NIEHAUS (1932), are given for comparison.

TABLE IV

Ranges of cell size in species of Hanseniaspora and Kloeckera

	No. strains studied	Range of cell width	Range of cell length
H. valbyensis	10	1.4—4.9 μ	2.6—11.5 μ
Type strain		1.8—5.3	3.5—10.8
	8	2—4	4—10 1)
H. uvarum	10	1.8—5.2	2.6—11.4
Type strain		1.8—4.9	3.5—10.8
		3.0—4.5	6—8 2)
		3.0—3.5	12—15 2)
K. apiculata	14	1.4—5.3	2.6—12.2
Type strain		1.8—4.4	3.5—10.2
	15	2.0—4.5	5—8 1)
H. osmophila	7	2.6—7.0	3.5—15.7
Type strain		2.1—5.3	3.5—14.0
		4.0—4.5	10.5—11 3)
K. magna	9	2.3—6.1	3.0—15.7
Type strain		2.6—4.9	4.9—14.0
	2	3.5—6	5.5—10 1)
K. corticis	1	3.5—6.0	5.5—14.8
Type strain		2.6—5.4	4.4—13.6
	1	4.5—7.5	8—18 1)
K. africana	1	1.8—5.3	4.4—13.6
Type strain		2.1—5.6	4.4—14.0
	2	3.5—5.5	7.5—12 1)
K. antillarum		1.8—3.9	2.1—7.9
Type strain	4	2.5—5.5	4—9 1)
K. javanica		2.1—3.9	3.5—10.9
Type strain	1	3.5—6	7—11 1)
K. jensenii	1	2.1—3.9	3.5—9.1
Type strain		2.1—4.4	3.5—8.8
	2	2—3.5	4—7 1)
K. lafarii		2.1—3.9	3.5—10.5
Type strain	1	2—4	4—10.5 1)

1) Cell size range as given by LODDER & KREGER-VAN RIJ (1952).

2) Cell size range as given by NIEHAUS (1932). He recognized two groups of cell sizes in this species.

3) Cell size range as given by NIEHAUS (1932).

When the variations in the cell sizes of strains of a given species are listed, wide differences in the extremes of the widths and lengths of the cells become apparent. These data are given in Table V. It will be noted that variations such as exist between strains of a species are such that the use of ranges of cell size for specific differentiation in the apiculate yeasts becomes extremely difficult.

TABLE V

Range of Cell Dimensions of Strains of Apiculate Yeasts belonging to the Same Species

Name	No. strains examined	Minimal Width (μ)	Maximal Width (μ)	Minimal Length (μ)	Maximal Length (μ)
H. valbyensis	11	1.4—2.6	3.9—5.3	2.6—4.4	7.9—11.5
H. uvarum	11	1.8—3.1	3.9—5.2	2.6—3.8	7.9—11.4
K. apiculata	15	1.4—3.1	4.0—5.3	2.6—4.4	7.4—12.2
H. osmophila	8	2.6—4.0	4.4—7.0	3.5—6.1	10.5—15.7
K. magna	10	2.3—4.4	4.4—6.1	3.0—5.8	8.8—15.7
K. corticis	2	2.6—3.5	5.4—6.0	4.4—5.5	13.6—14.8
K. africana	2	1.8—2.1	5.3—5.6	4.4	13.6—14.0
K. antillarum	1	1.8	3.9	2.1	7.9
K. javanica	1	2.1	3.9	3.5	10.9
K. jensenii	2	2.1	3.9—4.4	3.5	8.8—9.1
K. lafarii	1	2.1	3.9	3.5	10.5

The separation of *K. magna* and *K. corticis* on the basis of cell size is not supported by the results obtained in this study. The range of extremes in cell size measurements for the two species are approximately the same. The differences between the type strains of the two species are negligible.

Kloeckera antillarum, *K. javanica* and *K. jensenii* are separated on the basis of the ratio of length to width and on actual cell size. Except for an additional strain of *K. jensenii*, only the type strains were available for study. The results obtained with these three species show that variations are such that identification of a newly isolated apiculate belonging to this group with a known species is nearly impossible. *K. antillarum*, which is characterized by having a length to width ratio of less than 2, has relatively wider cells than the other two species. However, only about half of the cells fitted this ratio. On the other hand, strains of the other two species, in which the length to width ratio should be 2 or greater, many of the measured cells had ratios of less than 2. It was concluded that the ranges of cell sizes of these three species are not sufficiently different to maintain these as separate species.

Discussion

The data presented in this study show conclusively that the spherical bodies formed by members of the genus originally called *Kloeckeraspora* by NIEHAUS (1932) are true ascospores. First, these yeasts under conditions favorable for spore formation have been shown to undergo meiosis. Nuclear chromatin stains clearly show two or four nuclei in some cells. Neither NIEHAUS (1932) nor DVORNIK (1938) were able to find evidence of reduction division in their stained preparations. Both investigators, however, observed germination of the spores in the asci. Second, the spherical spores stain in the same manner as ascospores of other sporogenous yeasts. Third, asci were micro-dissected and the spores were isolated. After being placed on a nutrient medium they germinated and formed colonies. The observations made on germinating spores in hanging drop cultures and the subsequent vegetative reproduction of the ascospore bud-cells formed the concluding proof.

The germination of the spores by a germ tube (NIEHAUS, 1932) could not be confirmed. The authors found that germination takes place by budding as reported by DVORNIK (1938).

The genus *Hanseniaspora* as proposed by ZIKES (1911) was for sporogenous apiculate yeasts which LINDNER (1904) had placed in the genus *Hansenia*. LINDNER claimed that these yeasts formed spherical spores. He defined the genus as follows: "apiculate yeasts which form spores". ZIKES did not give a new definition of the genus. GUILLIERMOND (1928) defined *Hanseniaspora* as "Cells with a characteristic lemon shape (apiculate shape), 1 to 2 ascospores per ascus, which are sometimes hat-shaped, sometimes without special shape (round)". STELLING-DEKKER (1931) stated that "the spores are at first spherical, later hat-shaped, which, however, is not always clear." NIEHAUS (1932) created the genus *Kloeckeraspora* for the apiculates forming spherical spores, since he felt that the definition given by STELLING-DEKKER excluded this group. LODDER & KREGER-VAN RIJ (1952) retained the sense of STELLING-DEKKER'S definition. Since the strains isolated by NIEHAUS had lost the ability to sporulate, they included these organisms provisionally in the genus *Kloeckera*, pending a further investigation of the round-spored species. The authors feel that a clarification of the genus description is desirable. Since the original description made no reference to the shape of the spores the creation of the genus *Kloeckeraspora* is not necessary. The description of STELLING-DEKKER is restrictive and should have been liberalized to include the strains forming spherical spores. The following description is based on the original meaning:

Cells lemon-shaped, oval or long-oval. Vegetative reproduction by bipolar budding. No formation of pseudomycelium. The spores are either spherical (one or rarely two per ascus) or hat-shaped (generally 4, rarely two per ascus). Fermentative ability. Nitrate is not assimilated.

That the ability to form spores is easily lost upon continued cultivation, has been noted by many investigators. LODDER & KREGER-VAN RIJ (1952) note that only one of the eight strains of *H. valbyensis* investigated still formed spores.

The sporogenous strain was isolated in 1924 from fermenting tomatoes in Holland. None of the strains of this species studied by the authors have shown a tendency to lose their ability to sporulate. This may be a difference between strains within the species. Some of our strains of *H. uvarum* and of *H. osmophila* have apparently lost the capacity to form spores while others, under laboratory cultivation, now produce a much lower percentage of asci than at the time of isolation. However, as shown in Fig. 8, areas in which a very high percentage of sporulation occurs, can be found in such strains. Single spore cultures were not found to be superior to the parent culture in their sporulating ability.

The life cycles of *H. valbyensis* and of *H. uvarum* are the same, except for the spore shape and the number formed per ascus. Diploidization apparently occurs in the germinating spore prior to budding since in some cases centrally located dikaryons were observed during germination. No evidence of conjugation between spores, buds or vegetative cells was found. This is similar to diploidization in *Saccharomyces chevalieri* in which WINGE & ROBERTS (1949) found a diploidization gene *D* which causes the spore nucleus to diploidize prior to budding. In *Saccharomycodes ludwigii* conjugation between spores in the ascus gives rise to diploid cells and in species of *Nadsonia*, the vegetative cells are haploid and diploidization occurs just prior to ascus formation by conjugation of the nuclei of a mother and daughter cell.

A comparison of *Hanseniaspora* to the other two genera in the tribe *Nadsonieae* shows that the tribe is probably composed of two somewhat related genera, *Hanseniaspora* and *Saccharomycodes*, and one unrelated genus, *Nadsonia*. Except for the shape of the cells and bipolar budding, members of *Hanseniaspora* and *Saccharomycodes* are similar to some species of the tribe *Saccharomyceteae*. The morphology of *Nadsonia* differs in that budding takes place on a very broad base approaching that of fission. The life cycle and spore shape are also quite different. A study of the cell wall composition (MILLER & PHAFF 1958) showed that the cell walls of *Hanseniaspora* and *Saccharomycodes* are similar to those of *Saccharomyces*, while the cell walls of *Nadsonia* are similar in composition to those of *Endomyces*. However, the authors feel that further study is necessary before the recommendation can be made to transfer *Nadsonia* to the subfamily *Endomycetoideae*.

The species of the genus *Kloeckera* could be separated into four groups. Strains included in *K. apiculata* are the imperfect forms of *H. valbyensis* or of *H. uvarum*. Strains of *K. magna* and *K. corticis* are imperfects of *H. osmophila*. The third group, which includes *K. antillarum*, *K. javanica*, *K. jensenii*, and *K. lafarii* could not be identified with any of the perfect apiculate species. *K. africana* is different from the other three groups.

From the results of this study it is believed that only 4 species and one variety of *Kloeckera* should be recognized. *K. apiculata* and

K. africana are maintained as separate species. It is proposed that *K. magna* and *K. corticis* be combined into one species, *Kloeckera corticis* (KLÖCKER) JANKE 1912. The specific name is based on the rule of priority in botanical nomenclature. These two species were separated only by a difference in cell size which could not be confirmed in this study. While the range of measurements of cell length for all 12 strains studied was 8.8 to 15.7 μ, the various strains did not split into two groups near these extremes, but rather formed a continuous series from the short cell lengths to the long cell lengths, (cf. Tables IV and V).

Kloeckera antillarum, *K. javanica* and *K. jensenii* also are so similar that they should be combined into one species. The choice of a specific name can not be made on the basis of priority since KLÖCKER described all three species in 1912. However, since *K. javanica* and *K. jensenii* were isolated by KLÖCKER from soil in Java, it is proposed to retain the specific name *K. javanica* and to consider *K. antillarum* and *K. jensenii* as synonyms of this species Unfortunately, not as many strains of this group are available for study as in the previously discussed group.

K. lafarii, also isolated from soil in Java, differs from the *K. javanica* group only by its inability to assimilate or ferment raffinose. Since there are no other significant differences it is proposed that *K. lafarii* be made a variety of *K. javanica*. In the identification of a newly isolated apiculate yeast having the characteristics of this group, particular care would have to be taken in ascertaining whether or not raffinose is utilized since even *K. javanica* assimilates and ferments this sugar weakly and latently.

Table VI gives the key characteristics for the separation of species of *Hanseniaspora* and *Kloeckera* based on the results and conclusions of this study.

Summary

A comparative study of the apiculate yeasts has been made. The spherical bodies formed in the cells of certain species of *Hanseniaspora* were shown to be true ascospores. Three species of *Hanseniaspora* are recognized, i.e. *H. valbyensis*, *H. uvarum*, and *H. osmophila*. The life cycles of species forming hat-shaped spores and of species forming spherical spores are similar. The vegetative cell is diploid. After meiosis the cell becomes an ascus, normally containing 4 hat-shaped spores, or 1, rarely 2, spherical spores, depending upon the species. Spores are uninucleate. Conjugation between spores or spore buds does not occur. Diploidization takes place in the germinating ascospore prior to budding. The buds, after detachment from the germinating spore, develop into vegetative cells. X-ray survival curves show that vegetative cells of *H. valbyensis* and of *H. uvarum* (including an asporogenous strain) are diploid. Vegetative cells of *K. apiculata* were shown to be haploid. Asporogenous forms may arise from sporogenous forms

TABLE VI

Key Characteristics for the Separation of Species of Hanseniaspora and Kloeckera

Species	Spores	Cell size in Liquid wort (μ)	Carbon Assimilation				Fermentation			
			Gluc.	Sucr.	Malt.	Raff.	Gluc.	Sucr.	Malt.	Raff.
H. valbyensis	Hat	(1.5—5.3) × (2.6—11.5)	+	—	—	—	+	—	—	—
H. uvarum	Spherical	(1.8—5.2) × (2.6—11.4)	+	—	—	—	+	—	—	—
H. osmophila	,,	(2.5—7.0) × (3.5—15.7)	+	—	+	—	+	—	—	—
K. apiculata	Absent	(1.4—5.3) × (2.6—12.2)	+	—	—	—	+	—	—	—
K. corticis	,,	(2.3—6.1) × (3.0—15.7)	+	—	+	—	+	—	—	—
K. javanica	,,	(1.8—4.4) × (2.1—10.9)	+	+	—	WL	+	+	—	WL
K. javanica var. lafarii	,,	(2.1—3.9) × (3.5—10.5)	+	+	—	—	+	+	—	—
K. africana	,,	(2.1—5.6) × (4.4—14.0)	+	+	+	—	+	—	—	—

+ indicates a positive assimilation or fermentation.

— indicates a negative assimilation or fermentation.

WL indicates that the assimilation is weak and latent and the fermentation in a van Iterson-Kluyver fermentometer is weak and delayed. N.B. Fermentation in Durham tubes is generally negative.

by mutation and selection or result from possible changes in nutritional and environmental conditions required for sporulation.

Four species and one variety of *Kloeckera* are recognized. These are *K. apiculata*, *K. africana*, *K. corticis*, *K. javanica* and *K. javanica* var. *lafarii*.

The range of size extremes for the vegetative cells of *Hanseniaspora* and *Kloeckera* were determined. The use of this character for species differentiation is of limited value. Carbon assimilation patterns, fermentative abilities and vitamin requirements were studied for members of the tribe *Nadsonieae* and of the genus *Kloeckera*.

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CONTRIBUTION TO THE KNOWLEDGE OF SOIL FUNGI IN ISRAEL

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(with 10 Figures in text)

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Introduction

The study of soil Fungi is of a very great importance and interest because of the fundamental part they play in the biology of the soil and in its chemical and physical processes. Furthermore, the soil can be considered as an immense reservoir of Fungi, where species causing important plant-diseases, species entering into symbiotic association with higher plants and species secreting chemotherapeutic and antibiotic substances can be found.

From the beginning of this century soil Fungi have been intensively studied in various parts of the world, especially Europe, America and Australia, and rich literature on this subject has accumulated. However, very few works, to our knowledge, have been published from the Middle East, and those are from Egypt (Sabet 1935, 1939; Ragab, 1956). As to Israel, the present work is the first publication on soil Fungi as such.

The majority of investigations on soil Fungi have been performed on those occurring in agricultural and forest soils. Little work has been done on soil Fungi of arid regions (Killian & Fehér, 1939; Moreau, 1945; Nicot, 1953, 1955), which are of special interest to us as the major part of our country is arid. Also most of the samples for this study have been taken from arid soils of the Judaean Desert along Jerusalem-Jericho road and eight localities in the Northern Negev along Beersheba-Sdom road (Mishmar Hanegev, Beersheba, 12 km. south of Beersheba, Tureiba, 22 and 12 km. to Sdom, and two salines of Sdom). Soil Fungi from cultivated fields, gardens, the sea-shore and river banks were also partly investigated, but at present these data are few.

This work puts forward a list of the species isolated from the above areas together with a description of the significant morphological characters and the collection data of each.

In the summary and conclusions lists are given of Fungi new or rare in soil and of Fungi common to the soils of Israel, Egypt and the Sahara.

The Fungi included in this Contribution have been cultivated (with very few exceptions) in pure cultures on different types of media. The Mucoraceae are described from cultures on bread and Czapek's medium, Cunninghamella from M.D.A. (according to CUTTER, 1946, p. 322); Aspergilli and Penicillia from Czapek's medium; the other Fungi mostly from potato-dextrose-agar.

A comprehensive study of soil Fungi occurring in the Northern Negev, has been done by the junior author and will be published in the near future. It deals with quantitative and qualitative data on the Fungi of these soils, their distribution and important physiological characteristics, as well as soil analysis.

Annotated Systematic List

PHYCOMYCETES

MUCORACEAE.

1. *Absidia glauca* HAGEM = *Tieghemella glauca* HAGEM = *Tieghemella tieghemii* NAUMOV.
Isolated by Z. FISCH from humus soil, beneath *Pinus halepensis*, in the gardens of the Hebrew University: Jerusalem, December 1940.

Stolons curved into arches carrying on their upper part 2—4 pear-shaped sporangia, 45—60 × 40—50 μ. Columellae rounded, mammiform, 30—35 μ broad, furnished with a short button; spores globose, 3—4 μ in diameter. Heterothallic.

Grows well, at 28—30° C, but the growth becomes abnormal at 34° C and stops at 35° C. In light, on Czapek and at 28° C. the turf attains 5 mm height, but in dark only 1 mm.

2. *Absidia spinosa* LENDNER = *Tieghemella cylindrospora* HAGEM = *Tieghemella spinosa* NAUMOV.
Isolated several times from soil beneath *Pinus halepensis* in the gardens of the Hebrew University: Jerusalem.

Stolons slightly curved carrying at the top of the arcs 1—3 sporangiophores; sporangia pyriform, 34—35 × 27—28 μ; apophysis funnel shaped; columellae about 20 μ in diameter, ending in a rather long spine; spores in form of short rodes, 4—5 × 2 μ, hyalin. Zygospores sphaerical or doliform, verrucose, produced "en masse" especially in dark but failing to appear when nitrogen absent from the medium; gametes unequal, circinate appendages on the larger suspensor. No growth above 34° C; optimal growth at pH=5.

3. *Actinomucor corymbosus* (HARZ) NAUMOV = *Mucor corymbolus* HARZ = *Actinomucor repens* SCHOSTAKOWITSCH = *Glomeruas repens* BAINIER = *Mucor glomerula* LENDNER = *Rhizopus elegans* EIDAM.
Forma *palaestina* RAYSS, f. nov.: a typo differt sporangiis minoribus et sporis majoribus.
Isolated by A. ZONENSCHEIN from soil in the gardens of the Hebrew University: Jerusalem, winter 1945; by S. BORUT from loess-soil at the depth of 10 cm.: Beer-Sheva, april 1954.

Sporangiophores erect, branched, terminated by a large sporangium, 82—102 μ in diameter (typically: 120—180 μ); lateral sporangia 37—50 μ in diameter, in whorls; columellae cylindro-conic; spores globose, 7—10 μ in diameter (typically 7 μ)

4. *Circinella nigra* BAINIER
Isolated by N. STIBEL from soil beneath *Phlomis brachyodon* at the depth of 25 cm.: Judaean Desert, 15 km. on the Jerusalem-Jericho road, June 1947.

Sporangiophores sympodially branched, yellow at base; sporangia on circinate pedicels, in two series: those below terminated by a hypha in the form of a spine, those above without spines. Sporangia black, 35—65 μ in diameter, with blue-black non diffluent wall; columellae broadly conical, blueish, with irregular spines on the top; spores globose, 3,5—5 μ in diameter. Differs from *C. spinosa* by the grayish shade of its colonies and the dark (black) colour of its sporangia. NAUMOV, however, (1939, p. XVI) connects these two species into one.

5. *Circinella sydowii* LENDNER = *Mucor laxorhizus* LING-YOUNG
Isolated by A. KRUGLIAKOW from calcareous soil in the tree-nursery of the Hebrew University: Jerusalem, January 1946.

Turf white then gray; sporangia 70—120 μ in diameter, on short and curved side-branches sometimes ending in sterile tips; columellae variable in shape, ca. 62 μ long and 33 μ broad, spinescent, grayish; spores smooth, blueish-gray, 6—8 × 6—7μ.

6. *Mucor adventitius* OUDEMANS = *M. humicolus* RAILLO (Sect. *Hagemia* NAUMOV, sect. *Hiemalis* ZYCHA)
Isolated by Z. FISCH from sandy soil beneath *Ficus sycomorus* Bath-Yam, December 1940.

Turf about 5 times higher in light than in dark failing to grow at 36°; sporangia 75—90 μ in diameter, with a diffluent membrane; columellae elliptic, 40—48 × 60 μ, with a basal collarette; spores elliptic-oblong, 7—8 × 3—5 μ, grayish in mass; optimal growth at pH=6.

7. *Mucor ambiguus* VUILLEMIN (sect. *Bonordenia* NAUMOV, sect. *Fragilis* ZYCHA).
Isolated by Z. FISCH, from sandy soil beneath *Cynodon dactylon*: Bath-Yam, December 1940.

Sporangiophores erect, forming a blackish-gray turf, 1 mm high; terminal sporangia globose, 100 μ in diameter, with more or less diffluent walls; successive sporangia are more persistent: their wall is fragile and breaks into pieces; columellae campanulate or globose; spores elliptic, 7 × 4,5 μ; numerous chlamydospores present.

8. *Mucor corticolus* HAGEM (sect. *Hagemia* NAUMOV, sect. *Hiemalis* ZYCHA).
Isolated by A. KRUGLIAKOV from sandy soil: Mishmar-Hayam, February 1946.

Turf blueish-gray, usually 2 but sometimes up to 3 cm high, sporangiophores 6—10 μ thick, sometimes with septations, sympodially branched; sporangia globose, 50—58 μ in diameter; columellae slightly oval, 35—45 μ long, 12—40 μ broad; spores oval or elliptic, 5—8 × 3—5 μ; chlamydospores present.

9. *Mucor geophilus* OUDEMANS (Sect. *Hagemia* NAUMOV, sect. *Racemosus* ZYCHA).
Isolated by Z. FISCH, in the gardens of the Hebrew University, beneath *Casuarina tenuissima*: Jerusalem, November 1940.

Colonies snow-white, becoming pale-olive; sporangiophores simple, sometimes branched in cymes; sporangia globose, 50—60 × 30—40 μ, olivaceous; columellae globose, brownish; spores smooth, globose or elliptic, 4—7 μ in diameter; numerous chlamydospores 20 μ in diameter on the mycelium; optimal growth at pH=6.

10. *Mucor griseo-cyanus* HAGEM (sect. *Heteropus* NAUMOV, sect. *Racemosus* ZYCHA).
Isolated by A. KRUGLIAKOV from soil in the gardens of the Hebrew University; Jerusalem, February, 1946.

Turf about 1 cm high; sporangiophores in two series; the lower one dark gray due to density of sporangia at this level; sporangia sphaerical, 57—75 μ in diameter, with a persistent grayish-blue wall; columellae more or less ovoid, 28—45 × 25—30μ, colourless or faintly fuliginous, spores oval, 4—6 × 3—4 μ, brown in mass.

11 *Mucor griseo-lilacinus* POVAH (Sect. *Heteropus* NAUMOV, sect. *Hiemalis* ZYCHA)
Isolated by A. KRUGLIAKOV from soil in the tree-nursery of the Hebrew University, beneath *Cupressus*; Jerusalem, January, 1946.

Turf mouse-gray with a faint lilac shade, 1—1,5 mm high; sporangiophores sympodially branched; sporangia 50—70 μ in diameter, yellowish at first, becoming dark gray; columellae globose, 17—30 μ in diameter, lilac-gray; spores elliptic, 4—6 × 3—4,5 μ, gray. Gelatine rapidly and completely liquefied.

12. *Mucor hiemalis* WEHMER (sect. *Hagemia* NAUMOV, sect. *Hiemalis* ZYCHA).
Isolated by A. KRUGLIAKOV from calcareous soil in the gardens of the Hebrew University, beneath *Cupressus* trees; Jerusalem, November, 1945.

Turf white, becoming pale grayish-yellow, 1—2 cm high; sporangia sphaerical, 45—58 μ in diameter; columellae more or less oval, colourless, 30—33 × 30 μ; spores elongated, smooth, 5—8 × 3—4 μ, hyalin. Mycelium and the culture medium assuming yellow shades owing to production of yellow oil-drops. Decomposes cellulose.

13. *Mucor mucedo* (LINNÉ) BREFELD = *M. brevipes* RIESS = *M. proliferus* SCHOSTAKOWITSCH (Sect. *Macromucor* NAUMOV, sect. *Mucedo* ZYCHA).
Isolated by A. KRUGLIAKOV from calcareous soil in the gardens of the Hebrew University; Jerusalem, January, 1946.

Sporangiophores not branched (or very rarely), silvery-gray, 5—8 cm high, 12—40 μ broad; sporangia 75—112 μ wide, at first yellow becoming then dark-gray; walls incrusted with crystals of calcium-oxalate, diffluent, leaving a collarette; columellae spherical or pear-shaped, 24—78 μ in diameter, with orange-red content; spores elliptic or subcylindric; 7—12 × 4—6 μ. Decomposes cellulose.

14. *Mucor plumbeus* BONORDEN (Sect. *Bonordenia* NAUMOV, sect. *Sphaerosporus* ZYCHA)
Isolated by A. KRUGLIAKOV from soil in the gardens of the Hebrew University; Jerusalem, February, 1946; from heavy soil, beneath *Prosopis farcta*: Jagur, January, 1946.

Turf very close, 1 cm high, mouse-gray, almost black; sporangiophores branched in sympodia; sporangia 80—105 μ in diameter, at first colourless then deep brown; columellae oval or pear-shaped, 62—70 × 22—27 μ, brown or smoke-coloured with a variable number of spines on their upper part; spores globose, gray-blue, 5—7,5 × 5—7 μ, with rough or dotted walls; chlamydospores present. Slightly decomposes cellulose.

15. *Mucor prainii* CHODAT & NECHITCH (Sect. *Hagemia* NAUMOV, sect. *Racemosus* ZYCHA).

Isolated by A. KRUGLIAKOV from sandy soil: Mishmar Hayam, January, 1942; from calcareous soil in the gardens of the Hebrew University: Jerusalem, February, 1946.

Sporangiophores scarcely branched in sympodia, colourless, 2 cm high; sporangia globose, brown, 55—75 μ in diameter; columellae smooth, globose or slightly elongated, 45—52 μ in diameter, with a basal collarette; spores subspherical, 3—6 × 3—5 μ. Chlamydospores variable in shape, colourless, with a thick wall, filled with starch.

16. *Mucor racemosus* FRESENIUS (Sect. *Byssomucor* NAUMOV, sect. *Racemosus* ZYCHA).
Isolated by Z. FISCH from soil beneath *Poa bulbosa* in the gardens of the Hebrew University; Jerusalem, December, 1940.

Turf yellowish-brown, sporangiophores of variable height, irregularly branched; sporangia small, globose, yellow or brownish, 20—60 μ in diameter; walls non diffluent, fragile, leaving a collarette; columellae globose, ovoid or campanulate, 50 μ long, 8—30 μ broad at their base, 10—40 μ at their larger part; spores elliptic, 7—10 × 3—8 μ. Chlamydospores very numerous, especially on the mycelium, but also in the conidiophores and even in the columellae, spherical, elliptical or cylindrical. No growth above 37° C.

17. *Rhizopus nigricans* EHRENBERG (Sect. *Ehrenbergia* NAUMOV).
Isolated by Z. FISCH from soil beneath *Arbutus andrachne* in the gardens of the Hebrew University: Jerusalem, September, 1940; by S. BORUT from loess soil at the depth of 10 cm.: Beersheba, March, 1955.

Aerial mycelium high; sporangiophores 0,5—3 mm long, 20—40 μ wide, arising in groups of 2—5 above nodes which are implanted in the substratum by means of rhizoids; sporangia black, sphaerical, 100—300 μ in diameter; columellae 70—90 μ in diameter; spores gray, unequal, round, oval or angular striate, 8—15 × 6—9 μ.

18. *Rhizopus nodosus* NAMYSLOWSKI (Sect. *Hanzawia* NAUMOV),: ZYCHA connects it with *Rh. arrizus* FISCHER.
Isolated by Z. FISCH from soil beneath *Arbutus andrachne* in the gardens of the Hebrew University: Jerusalem, September, 1940.

Mycelium cottony white at first, becoming yellowish with age, 1—2 mm high; rhizoids rare or lacking; sporangiophores arising from the mycelium or from stolons, frequently swollen at any part; in case of terminal swellings, a new group of 3—5 sporangiophores is formed; sporangia globose, 120—200 μ in diameter; columellae funnel-shaped; spores oval, angular, 6—9 × 4—6 μ with walls striated longitudinally.

CHOANEPHORACEAE.

19. *Cunninghamella bainieri* NAUMOV = *Muratella elegans* BAINIER & SARTORY.
Isolated by N. STIBEL from soil on the bank of the Alexander river, at the depth of 10 cm: Kefar Vitkin, November, 1946: by S. BORUT from loess soil at the depth of 10 cm and 25 cm; Mishmar Hanegev, November 1954 and March 1955.

Colonies grayish, up to 3 cm high, failing to grow at 40° C.; sterile mycelium branched, up to 18 μ wide, frequently swollen in the submerged portions; conidiophores branched in verticils below the terminal vesicle whose diameter is usually 45—48 μ; lateral vesicles smaller, 28—30 μ in diameter, smooth, sometimes verrucose; conidia of two sorts, normal globose or ovoid, hyalin, 5—15 μ in diameter, with slender echinulations; giant dark yellow to brown, 15—25 μ in diameter, with thick walls and stout 2—3 μ long echinulations, usually borne on verrucose subterminal vesicles.

20. *Cunninghamella bertoletiae* STADEL.
Isolated by S. BORUT from Hammada-soil, at the depth of 30 cm: 12 km to Sdom, April, 1954.

Colonies white to cream-gray, up to 2 cm high, growing at 40° C., vegetative mycelium branched, with some spherical chlamydospores, 30—40 μ in diameter; conidiophores erect, verticillately branched, 11—20 μ thick; lateral branches 40—55 μ long; vesicles 30—45 μ in diameter; conidia hyalin, lacrymoid, 10 × 7 μ, asperulate; larger conidia 14—21 × 10—12 μ are also found.

21. *Cunninghamella echinulata* (THAXTER) THAXTER = *Oedocephalum echinulatum* THAXTER = *C. africana* MATRUCHOT.
Isolated by N. STIBEL beneath *Prosopis farcta*, at the depth of 50 cm: Beth-Hashitta, December, 1946; by D. RIJIK in the gardens of the Hebrew University, at the depth of 16—20 cm: Jerusalem, March, 1947.

Turf white, becoming smoke-gray, 1—1,5 cm high; growing at 40° C; chlamydospores upon submerged portions; conidiophores dichotomously cymosely, but never verticillately branched, each branch terminated in a swollen vesicle, 18—30 μ, up to 48 μ broad; conidia globose to elliptical, 9—18 μ in diameter, finely echinulate.

II. ASCOMYCETES

GYMNOASCACEAE.

22. *Eidamella deflexa* (BERKELEY) BENJAMIN = *Myxotrichum deflexum* BERKELEY.
Isolated by S. BORUT from sandy soil at the depths of 25 and 50 cm: Tureiba, December, 1953; from Hammada-soil at the depth of 15 cm: 12 km to Sdom, December 1953; from loess-soil at the depth of 10 cm: Beersheba, April, 1954.

Cleistothecia black, sphaerical, 100—400 μ in diameter; peridial hyphae dark, branched, septate, 2,1—2,5 μ wide; asci hyalin, ovoid, 13—14 × 7—9 μ; ascospores hyalin, elliptical 4,5—6 × 2,1—2,5 μ.

23. *Gymnoascus reessii* BARANETZKY.
Isolated by S. BORUT from sandy soil, at the depths of 10, 25 and 50 cm: Tureiba, December, 1953; Hammada soil at the depth of 15 cm: 12 km to Sdom, December, 1953; loess-soil at the depths of 10, 25, 35 cm: Mishmar-Hanegev, November, 1954, March 1955; loess-soil at the depths of 10, 25 and 45 cm: Beersheba, December, 1953, November 1954, March 1955.

Perithecia white at first, becoming yellow to dark-orange at maturity, 200—480 μ in diameter; peridium loose, formed of anastomosed hyphae, 2—3 μ wide, furnished with spines 8—15 μ long; asci hyalin, elliptic 9—10 × 7 μ; ascospores subglobose to elliptic, yellow, 4—4,5 × 3—3,5 μ, with smooth walls.

24. *Myxotrichum emmonsii* KUEHN.
Isolated by S. BORUT from loess-soil at the depths 10 and 25 cm: Beersheba, April and November, 1954.

Cleistothecia light brown, sphaerical, 200—400 μ in diameter; peridial hyphae yellow-brown, septate, 2,8—3,2 μ wide, with thick, asperulate walls; short appendages numerous, septate, roughened, 33—34μ long; long appendages few in number, aseptate, smooth, roughened only near the base, 300—700 × 2,8 μ, loosely hooked at the apex; asci hyalin, oval, evanescent, 6,5—7 × 5,2—5,5 μ; ascospores hyalin, sphaerical, echinulate, 2,1—2,8 μ in diameter, adhering in a ball, 6,4—7 μ in diameter; vegetative hyphae yellowish, 1,4—1,5 μ wide; imperfect reproduction by oidia, 2,8—6 × 1,4—2 μ.

ASPERGILLACEAE.

25. *Aspergillus alliaceus* THOM & CHURCH (*A. Wentii* group). Isolated by N. STIBEL from soil beneath *Phlomis brachyodon*, at the depth of 25 cm: Judaean Desert, 14 km on the Jerusalem Jericho road, June, 1947.

Mycelium at first white bearing soon afterwards abundant dark sclerotia, 100—500 μ in diameter and a few conidiophores with ochraceous conidial heads; conidiophores 150 × 3—11 μ; vesicles subglobose, 30—60 μ in diameter; sterigmata in two series; conidia elliptical to globose, 1,5—3 μ in diameter.

26. *Aspergillus flavipes* (BAIN. & SART.) THOM & CHURCH = *Sterigmatocystis flavipes* BAIN. & SARTORY (*A. flavipes* group). Isolated by S. BORUT from loess-soil, at the depths of 10, 25, 45 cm: Beersheba, September, 1953.

Colonies yellowish, to light cinnamon; dark-yellow masses of helicoid thick-walled cells suggestive of sclerotia ("hülle cells") formed at the surface of the substratum; reverse developing shades cream, orange to dark-gray; colourless exudate produced; conidiophores 800—1000 × 5—6 μ with smooth yellow-brown walls; vesicles subglobose 13—19 × 16—22 μ, with diameter twice that of the conidiophore; sterigmata crowded, in two series: primary 7—8 × 2—3, secondary 5 × 1,5—2 μ; conidia smooth, hyalin 2—3 μ in diameter, forming columnar heads.

Two white mutants of this species were isolated: their colonies' colour white to pale rose, conidiophores smaller (100—220 × 5—6 μ) and so are the vesicles (12—18 μ).

27. *Aspergillus flavus* LINK = *Eurotium Aspergillus flavus* DE BARY & WORONIN = *A. humus* ABBOTT (*A. flavus oryzae* group).
Isolated by S. BORUT from loess-soil at the depth of 45 cm: Beersheba, September, 1954.

Conidial areas changing the colour during the development from yellow to light-green, dark green and brown in old cultures; reverse purple brown; conidiophores 800—1000 × 9—15 μ with spiny walls; vesicles 30—40 μ in diameter, fertile on the whole surface; sterigmata in most of the heads in single series, 9—10 × 3—4 μ, but sometimes in two series, primary 9—10 × 3—4 μ, secondary 7—8 × 2—3 μ; conidia 3—4 × 4,5—5 μ, subglobose to elliptical, with thick roughened walls, forming sphaerical or radiate conidial heads.

This species has been also isolated in our Laboratory from dead mosquitos sent to us from Haifa.

28. *Aspergillus fumigatus* FRESENIUS (*A. fumigatus* group). Isolated by S. BORUT from sandy soil, at the depths of 10, 25, 50 cm: Tureiba, September and December 1953, April and November 1954; from Hammada soil, at the depths of 30 and 35 cm: 22 km to Sdom, September and December 1953; from Hammada soil, at the depths of 15 and 30 cm: 12 km to Sdom, September and December, 1953, April 1954.

Two strains of this species have been isolated: first one with the final shade of the colony dark green, and the reverse yellow; conidiophores short, smooth, septate, 150—260 × 4,5—5 μ; vesicles 16—18 μ in diameter, flask-shaped, fertile on the upper half only; sterigmata in one series 5—7 × 2,5 μ; conidia globose, 2,5—3 μ, dark green in mass, forming columnar heads; second with floccose colonies; conidiophores formed only at the margins; colour of the colony becomes black with age; reverse passing through cream, yellow, orange to red; conidiophores 200—280 × 5,5—6,5 μ; vesicles 17—20 μ; sterigmata 5,5—6,5 × 2,5 μ; conidia echinulate, 3—3,5 μ in diameter.

29. *Aspergillus melleus* YUKAWA (*A. ochraceus* group).
Isolated by S. BORUT from loess-soil at the depths of 10 and 25 cm: Beersheba, April, 1954; from Hammada soil at the depth of 30 cm; 12 km to Sdom, December, 1953.

Colour of the colony honey-yellow; few cream to orange sclerotia, 500—700 μ in diameter; reverse cream to red; conidiophores with yellow pitted walls, 700—2000 × 11—15 μ. (In the diagnosis up to 1000 μ long and 15—20 μ wide); vesicles globose, 35—40 μ in diameter; sterigmata in two series: primary 12—13 × 4 μ; secondary 10 × 3 μ; conidia 2,5—3 μ in diameter, smooth, globose, hyalin, forming spherical conidial heads, splitting into columnar masses.

30. *Aspergillus niger* VAN TIEGHEM = *Sterigmatocystis nigra* VAN TIEGHEM = *A. fuscus* SCHUMANN (*A. niger group*).
Isolated by S. BORUT from loess-soil at the depth of 25 cm: Mishmar Hanegev, November, 1954.

Colonies black; sterile mycelium yellowish; reverse yellowish-green; conidiophores arise from the substratum, 1000—2000 × 12—20 μ, with thick, smooth yellow walls; vesicles globose, 35—50 μ in diameter, yellowish-brown; sterigmata brown in two series: primary 22 × 6—7 μ; secondary 7 × 2,5 μ; conidia brown globose, with spinulose walls, 4—5 μ in diameter, forming globose or radiate conidial heads.

31. *Aspergillus niveus* BLOCHWITZ = *A. eburneus* BIOURGE (*A. terreus* group).
Isolated by S. BORUT from loess-soil at the depth of 35 cm: Mishmar Hanegev, September, 1953; from Hammada soil at the depth of 35 cm: 22 km to Sdom, September, 1953; from Hammada soil at the depth of 30 cm: 12 km to Sdom, September, 1953, April 1954.

Colony white to pale rose; reverse dark yellow to brown; conidiophores 300—800 × 4,5—8 μ, with smooth walls; vesicles 13—15 μ in diameter; sterigmata in two series: primary 5—5,5 × 2—2,5 μ; secondary 5—7 × 2—2,5 μ; conidia 2—3 μ in diameter, globose, smooth, colourless, arranged in snow-white loose columns.

32. *Aspergillus ochraceus* WILHELM (*A. ochraceus* group).
Isolated by N. STIBEL from desert soil, beneath *Chenolea arabica* at the depth of 10 cm: 21 km on the Jerusalem-Jericho road, June, 1947; by S. BORUT from loess-soil, at the depth of 25 cm: Beersheba, November, 1954.

Colonies yellow-orange; reverse cream; conidiophores long, 2000 × 7,5—12 μ, with thick, yellow, roughened walls; vesicles globose, 30—40 μ in diameter (according to GILMAN (1957, p. 232) the diameter of vesicles is 60—75 μ, according to SABET (1939, p. 86) = 32—42 μ; the vesicles of our specimens agree with those of SABET); sterigmata in two series: primary 15 × 5—6 μ, secondary 10 × 2—2,5 μ; conidia globose, rough, 3—4 μ in diameter; sclerotia 500—1500 μ in diameter cream to orange.

33. *Aspergillus quercinus* (BAINIER) THOM & CHURCH = *Sterigmatocystis quercina* BAINIER (*A. ochraceus* group).
Isolated by S. BORUT from sandy soil at the depth of 50 cm: Tureiba, November, 1954.

Conidial areas in yellow sulphur shades; sclerotia scattered over the whole surface of the colony, 400—500 μ in diameter, dark orange at maturity; reverse orange; conidiophores 1000—1100 × 7,5—11 μ, with thick, yellow, rough walls; vesicles globose, 30—40 μ in diameter, easily crushed by light pressure; sterigmata in two series: primary 12—15 × 2,5—3 μ, secondary 8—10 × 2,5—3 μ; conidia smooth, globose, 2,5—3,5 μ in diameter.

34. *Aspergillus sclerotiorum* HUBER (*A. ochraceus* group).
Isolated by S. BORUT from loess-soil at the depth of 45 cm: Mishmar Hanegev, December, 1953.

Colonies developing ochraceous shades; sclerotia abundant, appearing within 3 days, scattered over the whole mycelium, 1000—2000 μ in diameter, cream when mature; conidiophores 200—530 × 5—7,7 μ, with yellow roughened walls; vesicles subglobose, 16—22 μ in diameter; sterigmata in two series: primary 9—17 × 4,5—5 μ, secondary 9 × 2—2,5 μ; conidia globose, smooth, 2—2,5 μ in diameter, forming columnar conidial heads.

35. *Aspergillus sulphureus* (FRES.) THOM & CHURCH = *Sterigmatocystis sulphurea* FRESENIUS (*A. ochraceus* group).
Isolated by S. BORUT from loess-soil at the depth of 10, 25, 35 cm: Mishmar Hanegev, September, December, 1953; April, November 1954; from loess-soil at the depth of 45 cm: Beersheba, September 1953, November 1954, March 1955.

Colour of the conidial areas yellow; reverse dark buff; conidiophores with firm, yellow, pitted walls, 700—1300 × 7—11 μ (according to GILMAN (1957, p. 230) the conidiophores on Czapek attain the height of 230 μ only); vesicles globose, 20—32 μ in diameter; conidia globose, yellow, smooth, 2—3 μ in diameter, forming spherical conidial heads, splitting into columns with age; sclerotia 500—2500 μ in diameter, appearing in some isolates.

36. *Aspergillus terreus* THOM = *A. galeritus* BLOCHWITZ = *A. venetus* MASSEE (*A. terreus* group).
Isolated by D. RIJIK from cultivated soil, beneath *Trifolium alexandrinum*, at the depth of 10—15 cm: Gheva, March, 1947; by S. BORUT from loess-soil at the depths of 10 and 35 cm: Mishmar Hanegev, November, 1954, March, 1955; from Hammada soil at the depth of 20 cm: 22 km to Sdom, September, 1953.

Conidial areas in cinnamon shades, producing amber exudate; reverse dark brown; conidiophores 150—250 × 4,5—7 μ with smooth, colourless walls; vesicles globose, 12—18 μ in diameter; sterigmata crowded, parallel, in two series: primary 6—8 × 2—2,5 μ, secondary 5—7 × 1,5—3 μ; conidia yellowish, smooth, slightly elliptical, 1,8—2,5 μ in diameter, forming long columnar heads.

This species has been isolated in our country from branches and flowers of Shamouti orange trees (MINZ, 1946).

37. *Aspergillus ustus* (BAINIER) THOM & CHURCH = *Sterigmatocystis usta* BAINIER = *A. insuetus* (BAINIER) THOM & CHURCH = *A. minutus* ABBOTT (*A. ustus* group).
Isolated by S. BORUT from loess-soil at the depth of 25 and 35 cm: Mishmar Hanegev, December, 1953.

Colony floccose, at first white, passing through yellow-brown, gray, olive-gray to gray-brown; reverse yellow-orange to brown; orange-brown exudate produced; conidiophores small, 130—150 × 3,5—6 μ, borne on aerial mycelium, septate, with thin smooth walls; vesicles hemispherical, small, 5—10 μ in diameter; sterigmata in two series, colourless or sometimes pale-brown: primary 4,5—5 × 3 μ, secondary 5—6 × 2—2,5 μ; conidia globose, hyalin, 3—5 μ in diameter, rough, spinulose or adorned with conspicuous olive-gray bars, arranged in loose spherical heads and forming then compact columns; globose "hülle cells" present.

37b. *Aspergillus ustus* (BAINIER) THOM & CHURCH, var. *laevis* BLOCHWITZ (*A. ustus* group).
Isolated by S. BORUT from Hammada soil at the depth of 30 cm: 12 km to Sdom, March, 1955.

Colonies floccose, gray, producing yellow exudate; reverse yellow-green; conidiophores 100—135 × 3—5 μ, arising mostly from aerial mycelium; vesicles 16 × 5—8 μ; sterigmata in two series: primary 4,5—5 × 3 μ, secondary 5 × 2,5 μ; conidia brick-red in colour, rough, 4—4,5 × 3,5—5 μ; many twisted and curved "hülle cells" present.

38. *Aspergillus versicolor* (VUILL.) TIRABOSCHI = *Sterigmatocystis versicolor* VUILLEMIN = *A. diversicolor* WAKSMAN = *A. globosus* JENSEN = *A. tiraboschi* CORBONE (*A. versicolor* group).
Isolated by S. BORUT from loess-soil, at the depth of 25 cm: Mishmar Hanegev, December, 1953; from loess-soil, at the depth of 10 cm: Beersheba, April, 1954; from sandy dune soil, at the depth of 25 and 50 cm: 12 km south of Beersheba, December, 1953, March, 1955; from sandy soil, at the depths of 25 and 50 cm: Tureiba, December, 1953; from Hammada soil, at the depths of 20 and 35 cm: 22 km to Sdom, December, 1953, April, 1954; from Hammada soil, at the depths of 15 and 30 cm: 12 km to Sdom, December, 1953.

Colonies white at first, passing through yellow-green to pea-green; reverse rose to purple-red in old cultures; conidiophores 400—500 × 5—9 μ, with smooth colourless walls; vesicles sometimes green, 11—13 μ in diameter; sterigmata green in two series: primary 8 × 3 μ, secondary 6 × 2 μ; conidia green, globose, delicately echinulate, 2,5—4 μ in diameter, borne in loose chains and forming spherical or hemispherical conidial heads.

39. *Aspergillus wentii* WEHMER (*A. wentii* group).
Isolated by S. BORUT from loess-soil, at the depth of 25 cm: Beersheba, September, 1953.

Colonies white, passing through yellow, orange, brown and becoming chocolate-brown in old cultures; reverse yellowish then reddish-brown; conidiophores long, 1000—3000 × 9—16 μ, with smooth walls; vesicles 33—60 μ in diameter; sterigmata in two series: primary 10—11 × 4,5—5 μ, secondary 7—8 × 3 μ; conidia yellow, globose, 4,5—5,5 μ in diameter, with rough, double wall, borne in long chains and forming spherical conidial heads; black sclerotia produced in stock cultures.

40. *Aspergillus* — reduced form I (Figs. 1—2).
Isolated by S. BORUT from loess-soil at the depth of 10 cm: Beersheba, March, 1955.

Colony floccose, pale violet in center, with cream margins; reverse purple-brown; droplets of cream exudate produced; conidiophores arising from aerial mycelium, 6,5—9 × 2,5—3,5 μ, short, septate, straight or curved, vesicles indistinguishable from the conidiophore; few short and loose sterigmata in one or sometimes two series,

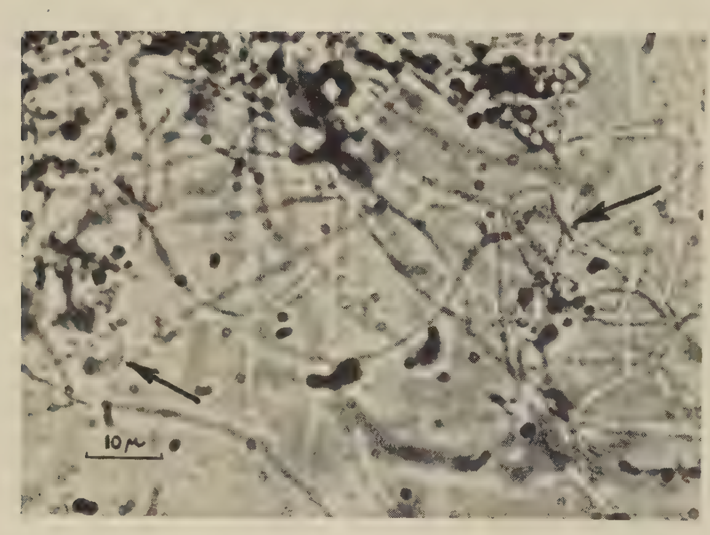

Fig. 1. *Aspergillus*, reduced form I.
Conidiophores

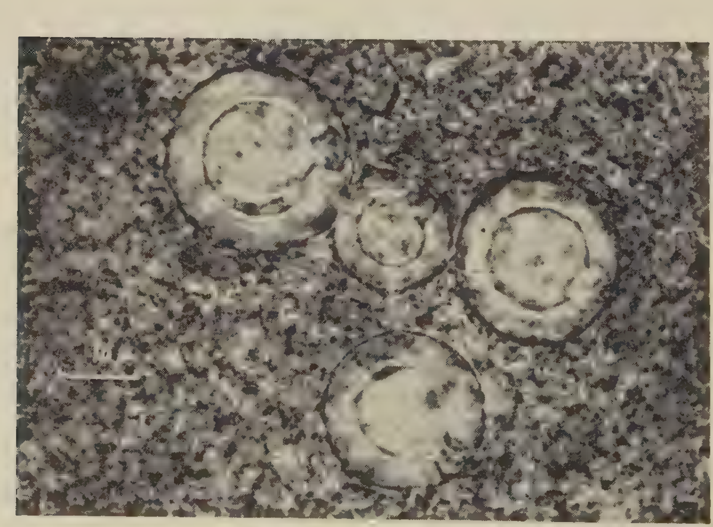

Fig. 2. *Aspergillus*, reduced form I.
Hülle-cells

mostly 2,5—3 × 2,2 μ; conidia hyalin, globose, 2—2,5 μ in diameter, with smooth walls, borne in short loose chains, producing many globose thick-walled "hülle cells", 12—25 μ in diameter.

41. *Aspergillus* reduced form II (Figs. 3—4).
Isolated by S. BORUT from loess-soil, at the depth of 25 cm: Beersheba, September, 1953.

Colony white, floccose, producing exudate; reverse white to cream; conidiophores arising from aerial mycelium only, short and thin, mostly 10—30 × 2—3 μ; vesicles degenerated and conidiophores similar to those of Penicillium; sterigmata in two series: primary 2—2,5 × 2 μ, secondary 2,5—3 × 2 μ; conidia white, smooth, globose, 2,5—3 μ in diameter, borne in short twisted chains; small clusters of globose "hülle cells", 20—27 μ in diameter produced.

42. *Penicillium atramentosum* THOM (Asymmetrica — Velutina: *P. oxalicum* series).
Isolated by S. BORUT from sandy soil at the depth of 10 cm: Tureiba, November, 1954.

Colony spreading, velvety; marginal area 3 mm broad, white; fruiting areas blueish-green, becoming green to dark-olive; reverse dark-brown in the center, shading through lighter tints towards the margin; conidial structures abundant, arising primarily from the substratum; conidiophores 50—150 × 2,8—3,5 μ; branches 10—20 × 2,5—3 μ; metulae 8—10 × 2,1—2,8 μ; sterigmata 7—9 × 2,1—2,5 μ; all parts of the conidiophore smooth; conidia subglobose, smooth, 2,8—4 μ in diameter; conidial chains divergent and tangled with those of adjacent heads.

43. *Penicillium baarnense* VAN BEYMA = *Carpenteles baarnense* VAN BEYMA (Asymmetrica Divaricata: *Carpenteles* series).
Isolated by S. BORUT from sandy soil at the depth of 10 cm: Tureiba, April, 1954.

Colonies at first white, becoming buff with the appearance of the perithecia; conidial areas blue-green; reverse light golden-tan; conidiophores 200—360 × 2,5—3 μ, arising from the substratum and from aerial hyphae; walls smooth; metulae 3 to 5, 12—15 × 2,1—2,8 μ; sterigmata 3 to 7, 8—9 × 2,1—2,5 μ; conidia smooth, globose to subglobose, 2,8—3 × 2,5—2,8 μ; perithecia abundant, globose to oblong, 100—200 μ in diameter; asci few in number, 10,5—11,5 μ in diameter, developing after 4 weeks, arising as side-branches from fertile hyphae; ascospores roughened with two equatorial ridges, 3,5—4 μ.

44. *Penicillium brevi-compactum* DIERCKX = *P. bialowiezense* ZALESKI = *P. hagemi* ZALESKI = *P. patris-mei* ZALESKI = *P. szaferi* ZALESKI (Asymmetrica — Velutina: *P. brevi-compactum* series).
Isolated by S. BORUT from loess-soil at the depth of 25 cm: Mishmar Hanegev, November, 1954.

Colonies velvety, green; reverse yellow-brown in the center, olive-green towards the margins; conidial structures abundant, arising from the substratum; conidiophores 330—400 × 4,2—5 μ, erect, rigid, with thick slightly roughened walls; forming coremia in the center of the colony; branches in groups of 2 or more, 12,5—14 × 4,2—7 μ; metulae 9—14 × 4—6,5 μ; sterigmata 8,5—10 × 3—3,5 μ; conidia globose to subglobose, finely roughened, 3,5—4,2 μ in diameter; conidial chains tangled, forming a loose mass.

45. *Penicillium chrysogenum* THOM = *P. baculatum* WESTLING = *P. roseo-citreum* BIOURGE (Asymmetrica — Velutina: *P. chrysogenum* series).

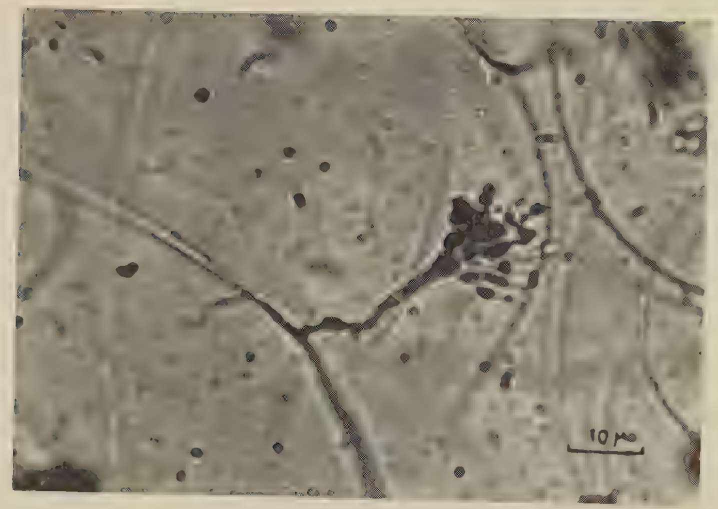

Fig. 3. *Aspergillus*, reduced form II.
Conidiophore

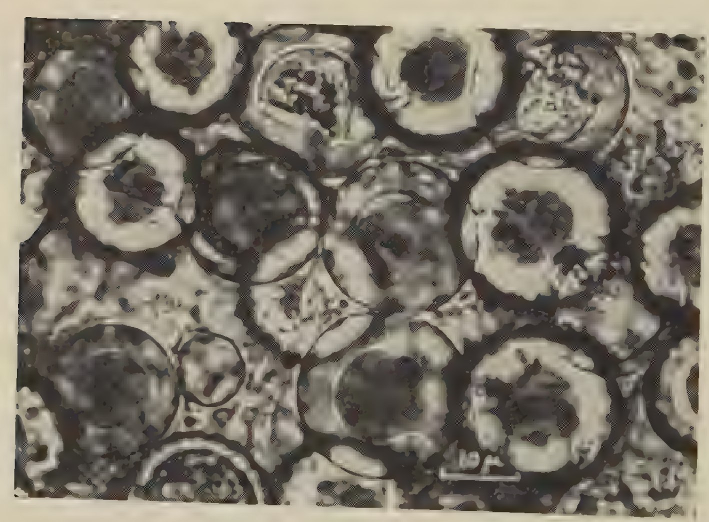

Fig. 4. *Aspergillus*, reduced form II.
Hülle-cells

Isolated by S. BORUT from sandy soil at the depths of 10 and 50 cm: Tureiba, April, 1954, from a saline at the depths of 10, 25, and 50 cm: 2 km north of Sdom, November, 1954.

Colonies velvety, heavily sporing, gray-green; yellow drops of exudate produced; reverse bright-yellow, colouring the surrounding agar in the same shade; conidiophores arising from the substratum or from aerial hyphae, 200—600 μ long, 3—3,5 μ thick, with smooth, colourless walls; penicilli bi-verticillate, but sometimes possessing one or two branches, 15—25 × 2,5—3,5 μ; metulae 3 to 4, 9—12 × 2—3 μ; sterigmata 3 to 6, 7—9 × 2—3 μ, narrowing towards the tips; conidia elliptical to subglobose, 3—4 μ (sometimes 4,5) long, 2,8—3,5 μ broad, smooth; conidial chains forming loose columns.

46. *Penicillium citrinum* THOM = *P. aurifluum* BIOURGE (Asymmetrica — Velutina: *P. citrinum* series).
Isolated by S. BORUT from sandy dune soil at the depths of 10, 25 and 35 cm: 12 km south to Beersheba, September, December, 1953, November, 1954; from sandy soil at the depth of 25 and 50 cm: Tureibá, September, 1953, March, 1955; from Hammada soil at the depth of 15 cm: 12 km to Sdom, April, 1954; from Hammada soil, at the depth of 35 cm: 22 km to Sdom, November 1954, March 1955; from loess-soil at the depth of 25 cm: Mishmar Hanegev, November 1954; from loess-soil at the depths of 10, 25 and 45 cm: Beersheba, November 1954, March 1955.

Colonies velvety to floccose, generally furrowed in a radial pattern; conidial areas blue-green at first, then olive-green, producing yellow exudate; reverse yellow to orange; conidiophores arising mostly from submerged hyphae, 50—200 × 2,1—3 μ; metulae 9—18 × 2,1—2,5 μ, enlarged at the apex to 4 μ; sterigmata 7—10 × 2—2,5 μ; conidia globose, smooth or roughened, 2,1—3,1 μ in diameter; conidial chains parallel, arranged in well defined columns.

Forms 1, 2 and 4 (according to RAPER & THOM, 1949, p. 347—349) were found among our isolates.

47. *Penicillium corylophilum* DIERCKX = *P. umbonatum* SOPP (Asymmetrica — Velutina: *P. citrinum* series).
Isolated by S. BORUT from loess-soil at the depths of 10 and 25 cm: Mishmar Hanegev, September, December, 1953; from Hammada soil at the depths of 20 and 35 cm: 22 km to Sdom, September, 1953; from Hammada soil at the depths of 15 and 30 cm: 12 km to Sdom, September, December, 1953.

Colonies velvety to floccose; occasionally radially furrowed; colour white at first, becoming pale green, blueish-green, olive-gray with age; colourless exudate produced in small droplets; reverse brown; conidiophores smooth-walled, most of them bi-verticillate, 50—100 (sometimes 200) μ long, 2,2—2,8 μ wide; metulae 9—15 × 2—3 μ; sterigmata 7—9 × 2—2,5 μ; conidia subglobose to elliptical, smooth, 2,5—3 × 2,5—2,8 μ; conidial chains tangled and forming loose columns.

48. *Penicillium egyptiacum* VAN BEYMA (Asymmetrica — Divaricata: *Carpenteles* series).
Isolated by S. BORUT from loess-soil at the depths of 10, 25 and 35 cm: Mishmar Hanegev, September, December 1953, April, November, 1954, March, 1955; from loess-soil at the depths of 10, 25 and 45 cm: Beersheba, dates as above; from

Hammada soil at the depths of 15 and 30 cm: 12 km to Sdom, December, 1953, April, 1954, March, 1955; from Hammada soil at the depth of 35 cm: 22 km to Sdom, March 1955.

Colonies floccose, conidiophores appearing in marginal areas, blue-green in colour; perithecia abundant, tan-coloured; some isolates producing colourless exudate; reverse pale-brown to light rose-brown; conidiophores smooth, 100—500 × 2,5—3μ; branches, when present, 15—25 × 2,5—3 μ; metulae divergent, 11—16 × 2,2—2,8μ sterigmata flask-shaped, 8—11 × 1,8—2,2 μ; conidia smooth, globose, 2,1—3 μ; in diameter, forming loose tangled chains; perithecia globose, sometimes elongate, 100—300 μ in diameter, ripening after 2—3 weeks; asci oval, 6—8 μ in diameter, borne in chains; ascospores lenticular, 2,8—3 × 2,2—2,8 μ, with two widely separated equatorial ridges.

49. *Penicillium frequentans* WESTLING = *P. aurantio-brunneum* DIERCKX = *P. flavidorsum* BIOURGE = *P. geophilum* OUDEMANS = *P. glabrum* WEHMER = *P. oledzkii* ZALESKI = *P. pfefferianum* WEHMER (Monoverticillata: *P. frequentans* series) Isolated by S. BORUT from loess-soil at the depth of 10 cm: Mishmar Hanegev, April 1954.

Colonies velvety, conidial areas grayish-green, surrounded by a sterile white margin, producing colourless exudate; reverse light purplish-brown; conidiophores short, smooth, 50—70 × 3—3,5 μ, enlarged at the apex to a swelling up to 4 μ in width; sterigmata in one series, 8—10 × 2,8—3 μ; conidia globose, smooth, 2,5—3,2 μ in diameter; conidial chains in well defined columns.

50. *Penicillium fuscum* (SOPP) RAPER & THOM = *Citromyces fuscus* SOPP (Monoverticillata: *P. restrictum* series).
Isolated by S. BORUT from Hammada soil at the dept hof 30 cm: 12 km to Sdom, Septembre, 1953.

Colonies spongy, 3 mm deep; conidial areas olive gray at first, becoming then grayish-brown; reverse light buff; conidiophores 50—100 × 2—2,5 μ arising mostly from aerial hyphae, short, septate, with smooth, thick, yellowish walls; penicilli mostly monoverticillate, sometimes irregularly branched; sterigmata 7—8,5 × 2—2,5 μ, with well defined conidium-bearing tips; conidia globose, spinulose, 3—4 μ in diameter, at first colourless, then light olive-brown, borne in tangled chains.

51. *Penicillium janthinellum* BIOURGE (Asymmetrica — Divaricata: *P. janthinellum* series).
Isolated by S. BORUT from Hammada soil at the depths of 20 and 35 cm: 22 km to Sdom, September, December, 1953; from sandy soil at the depths of 10, 25 and 50 cm: Tureiba, September, 1953, March, 1955; from loess-soil at the depths of 10, 25 and 35 cm: Mishmar Hanegev, April and November, 1954, March, 1955.

Colonies floccose, zonate; central areas small, cream-rose, formed by sterile hyphae; conidiophores abundant in submarginal areas, grayish-green to gray; growing margin broad, white to pale-rose; colourless to ambershaded exudate produced; colour of reverse different in various isolates, yellow-green, green, orange-brown to purple-red; short conidiophores, 10—50 μ long, arising from aerial hyphae; those arising from the substratum are longer, 100—200 × 2,5—5 μ, with smooth or finely roughened walls; penicilli mostly bi-verticillate, but in some strains monoverticillate; branches 15—28 × 2,5—3 μ; metulae divaricate, 7—15 × 2—2,5μ, with vesiculose apices; sterigmata 7—9 × 2—2,2 μ tapering to a long conidium bearing tube; conidia elliptical to subglobose, 2,8—3 × 2,8 μ, apiculate,finely roughened

52. *Penicillium jenseni* ZALESKI = *P. chrzaszczi* ZALESKI (Asymmetrica — Divaricata: *P. canescens* series).
Isolated by S. BORUT from loess-soil at the depths of 10, 25 and 35 cm: Mishmar Hanegev, September, 1953, April, 1954, March, 1955; from loess-soil at the depths of 10 and 25 cm: Beersheba, December, 1953; from sandy dune soil, at the depth of 25 cm: 12 km south of Beersheba, April, 1954; from sandy soil at the depths of 10, 25 and 50 cm: Tureiba, December, 1953 and March, 1955.

Colonies velvety or floccose with loose, granular surface; conidial areas grayish-green; odor lacking in some strains, pepper-like in others; reverse buff to light orange; conidiophores 20—200 μ long, 2—2,5 μ thick (those borne on aerial hyphae being short and monoverticillate); penicilli divaricate, sometimes ramigenous; metulae 8—12 × 2—2,3 μ; sterigmata 7—8 × 2 μ, tapering towards the apex; conidia globose, smooth or slightly roughened; 2—2,5 μ in diameter; conidial chains in loose columns.

53. *Penicillium lanosum* WESTLING (Asymmetrica — Lanata: *P. commune* series).
Isolated by S. BORUT from loess-soil, at the depth of 35 cm: Mishmar Hanegev, April, 1954.

Colony floccose, irregularly wrinkled; conidial areas grayish-green to gray, central area white; exudate limited; reverse light yellowish; conidiophores borne mostly on aerial hyphae, 100—200 × 2,5—3 μ, smooth; penicilli large, divergent; branches 15—17 × 2—2,5 μ; metulae 7—11 × 2—2,5 μ; sterigmata crowded, 7—8 × 2—2,1 μ; conidia globose, smooth, 2,5—3 μ in diameter, forming irregular spore masses.

54. *Penicillium levitum* RAPER & FENNELL (Monoverticillata: *P. javanicum* series).
Isolated by S. BORUT from sandy soil, at the depth of 50 cm: Tureiba, December, 1953.

Colonies velvety, at first white, becoming buff with age; reverse in yellow and lilac alternating zones; exudate limited, colourless; perithecia numerous, sclerotioid, 100—200 or even 300 μ in diameter; asci and ascospores produced on potato-dextrose agar after 7—14 days, but never on Czapek's medium; asci evanescent, 8—12 μ in diameter, borne as lateral branches from fertile hyphae not in chains, ascospores globose or oval, 4—4,5 μ in diameter, with thick smooth walls; conidiophores few in number, not influencing the colony's appearance, 100—130 μ long, 2,5—3 μ thick, bearing one verticil of 2 to 4 sterigmata, 8,4—9 × 2,2—3 μ; conidia globose to subglobose, smooth, 2,5—4 μ in diameter, in short divergent chains.

55. *Penicillium lilacinum* THOM (Asymmetrica — Divaricata: *P. lilacinum* series).
Isolated by S. BORUT from Hammada soil at the depths of 20, 35 cm: 22 km to Sdom, December, 1953, April, 1954, March, 1955; from Hammada soil at the depth of 30 cm: 12 km to Sdom, March, 1955; from loess-soil at the depths of 25 and 35 cm: Mishmar Hanegev, April, 1954, March, 1955; from loess-soil at the depths of 10 and 25 cm: Beersheba, March, 1955; from sandy soil at the depths of 25, 50 cm: Tureiba, March, 1955.

Colony loosely floccose, at first white, then lilac to lilac gray, producing limited colourless exudate; reverse colourless at first, becoming lilac-rose to dark purple with age; conidiophores arising from the substratum or from aerial hypha, 100—700

× 2,2—3 μ, with yellow, thick, finely roughened walls; metulae divergent, 6—8 × 2,5—3 μ arranged in few whorls; sterigmata 6,5—9 × 1—2 μ, born on the metulae or sometimes directly on the conidiophore, flask-shaped, divergent at the apices, acuminate; conidia smooth, elliptical, 2,5—3 × 2 μ, in tangled chains.

56. *Penicillium melinii* THOM (Asymmetrica — Divaricata: *P. nigricans* series).
Isolated by S. BORUT from Hammada soil, at the depth of 20 cm: 22 km to Sdom, April, 1954.

Colonies velvety, close-textured, yellowish-green at first, becoming grayish-green with age; limited yellow-orange exudate produced; reverse dark, purplish-brown; conidiophores 50—120 × 2,5—3 μ; penicilli sometimes irregular; metulae divergent, 10,5—13 × 2—2,5 μ; walls of the conidiophores and metulae conspicuously granular; sterigmata smooth, crowded, 6,3—7 × 2—2,5 μ; conidia globose, echinulate, 2,8—3,5 μ in diameter, in divergent chains.

57. *Penicillium miczynskii* ZALESKI (Asymmetrica — Divaricata: *P. janthinellum* series).
Isolated by S. BORUT from loess-soil at the depth of 10 cm: Beersheba, April, 1954.

Colonies restricted in growth, floccose, very much wrinkled, especially in center; yellowish-green at first, then grayish-green; limited uncoloured exudate produced, reverse bright yellow; vegetative hyphae yellowish; conidiophores 360—400 × 2,1—2,5 μ, with smooth walls, ending in a verticil of 3 to 5 divergent metulae, 11—14 × 2—2,5 μ; sterigmata 7—9 × 1,5—2 μ, narrowed to a short conidium-bearing tube; conidia subglobose to elliptical, smooth, 2,8—3 × 2,1—2,5 μ, in tangled chains.

58. *Penicillium multicolor* GRIGORIEVA-MANOILOVA & PORADIELOVA (Monoverticillata: *P. implicatum* series) (Fig. 5).
Isolated by S. BORUT from loess-soil at the depth of 25 cm: Mishmar Hanegev, December, 1953.

Colonies spreading, velvety, floccose, blue-green at first, becoming gray-green with age; exudate produced in uncoloured droplets; reverse orange-red; vegetative mycelium studded with orange-red crystals or granules, which dissolve when mounted in lactophenol so that they can be seen only in fresh condition and in water; conidiophores 20—40 × 2,2—2,5 μ with smooth walls and enlarged apices; sterigmata 6—8 × 2—2,8 μ; conidia globose, hyalin, smooth, 2,5—3 μ in diameter, in loose parallel chains.

59. *Penicillium ochro-chloron* BIOURGE (Asymmetrica — Divaricata: *P. janthinellum* series).
Isolated by S. BORUT from loess-soil at the depth of 10 cm: Mishmar Hanegev, April, 1954.

Colonies floccose, 0,5—1 cm high; mycelium at first white then ochre-yellow; conidiophores few in number in marginal and submarginal zones; limited colourless exudate produced; odor sourish; reverse buff-red in the center, yellowish-orange at the margin; conidiophores borne on aerial hyphae, 150—180 × 2—2,5 μ with roughened walls; metulae divergent, 11—18 × 2,2—5 μ with roughened walls, too; sterigmata 7—8,5 × 2—2,2 μ with long tapering apices; conidia elliptical, 2,5—2,8 × 1,5—2 μ, with smooth walls, in tangled conidial chains.

60. *Penicillium oxalicum* CURRIE & THOM (Asymmetrica — Velutina: *P. oxalicum* series).
Isolated by S. BORUT from loess-soil at the depth of 10 cm: Mishmar Hanegev, March, 1955.

Colonies velvety, plane, heavily sporing, mature conidia forming a layer which falls away "en masse"; conidial areas dark green-blue, becoming deep gray-green with age; reverse pale yellow; conidiophores 100—200 × 3,5—4,5 μ, with smooth walls; branches 10—30 × 3,5—4,5 μ; metulae 10—20 × 3—3,5 μ; sterigmata 9—11 × 2,8—3,2 μ; conidia elliptical, smooth, 4,5—6,4 × 3—3,4 μ; conidial chains forming long columns, which become entangled with adjacent columns and form a silky spore layer.

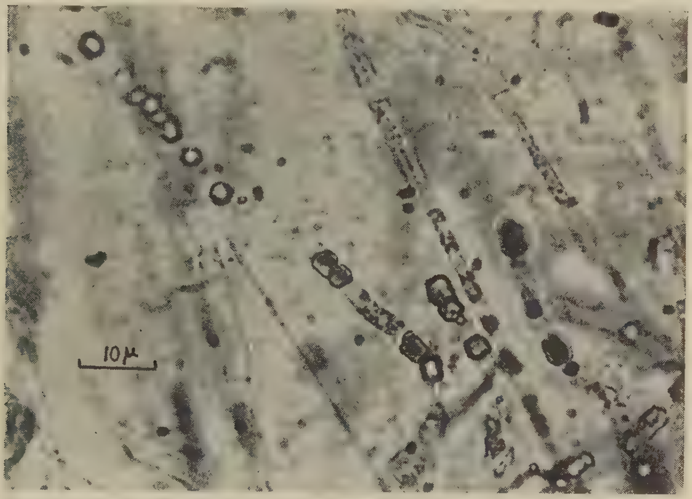

Fig. 5 *Penicillium multicolor* G.-M. and P.
Mycelium studded with orange-red granules

61. *Penicillium raciborskii* ZALESKI (Asymmetrica — Divaricata: *P. nigricans* series).
Isolated by S. BORUT from loess-soil at the depth of 25 cm: Beersheba, December, 1953 and March, 1955.

Colonies floccose, very much wrinkled, producing limited exudate; conidial areas grayish-green; reverse pale yellow, orange to vinaceous; conidiophores 65—200 × 2—3 μ, with smooth walls (on P.D.A. slightly roughened); metulae divergent, 8—12 × 2—3 μ, with vesicle-like swollen apices; sterigmata compact, 7—7,5 × 1,4—2 μ, narrowed towards the apex; conidia globose to subglobose, smooth (on P.D.A. finely granular), 1,5—2,1 μ in diameter; conidial chains in well defined columns.

62. *Penicillium steckii* ZALESKI (Asymmetrica — Velutina: *P. citrinum* series).
Isolated by S. BORUT from loess-soil at the depth of 35 cm: Mishmar Hanegev, April, 1954.

Colonies velvety, green, becoming gray with age, with a white, 2 mm wide growing margin; reverse at first colourless then olive-buff; conidiophores arising mostly from the substratum, 200 × 2,8—3 μ; metulae 10—14 × 2,8—3 μ; sterigmata crowded, 8—9 × 2—2,2 μ, narrowed towards the apex; conidia globose, smooth, 2—2,8 μ in diameter; conidial chains arranged in divergent well defined columns.

63. *Thielavia terricola* (GILMAN & ABBOTT) EMMONS = *Coniothyrium terricola* GILMAN & ABBOTT.
Forma *minor* RAYSS & BORUT, forma nov. (Fig. 6).
A typo differt ascis et sporidiis minoribus.
Isolated by S. BORUT from sandy-dune soil, at the depth of 10 cm: 12 km south of Beersheba, November, 1954.

Sterile mycelium white; reverse gray; perithecia spherical, 100—180 μ in diameter, appearing after 10 days, at first dark-gray then black; peridium brown, pseudoparenchymatic, with masses of dark spores seen within; asci elliptical, 22—25 × 15—16 μ (in the type: 25—35 × 16—19 μ); ascospores brown, elliptical, slightly apiculate at both ends, 8—12 × 5—6 μ (in the type: 10—16 × 7—9 μ).

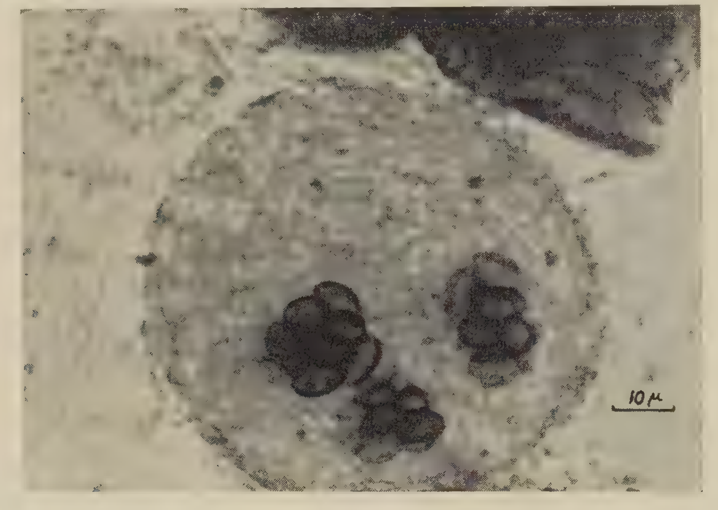

Fig. 6. *Thielavia terricola* (GILM. & ABBOTT) EMMONS f. *minor* RAYSS & BORUT
Perithecia with groups of ascospores seen within

OPHIOSTOMATACEAE.

64. *Microascus trigonosporus* EMMONS & DODGE (Figs. 7—8).
Isolated by S. BORUT from loess-soil at the depths of 10 and 35 cm: Mishmar Hanegev, September and December, 1953; from loess-soil at the depth of 25 cm: Beersheba, November, 1954; from sandy soil at the depth of 25 cm: Tureiba, April, 1954.

Colonies at first white, floccose; reverse cream; perithecia appearing after 25 days, at first gray, becoming black with age, 130—200 μ in diameter, ostiolate and sometimes with a short, wide neck; asci evanescent, 8—9 × 6,6—7,5 μ; ascospores yellow-orange, triangular, sometimes four-cornered, 4,5—5,5 μ wide, discharged from the perithecium as a long reddish-orange cirrhus, 25—35 μ in diameter.

One of our isolates produced the imperfect stadium = *Scopulariopsis*, colour of the respective colony being grayish-brown, conidiophores numerous, ending in a whorl of sterigmata, 5—6,6 × 2,5—3 μ, swollen at their middle portion; conidia spinulose, sub-globose to oval, 4,4—5,5 × 2,5—4 μ, in chains. (Conidiophores sometimes lacking and then the chains of conidia arise directly from the mycelium).

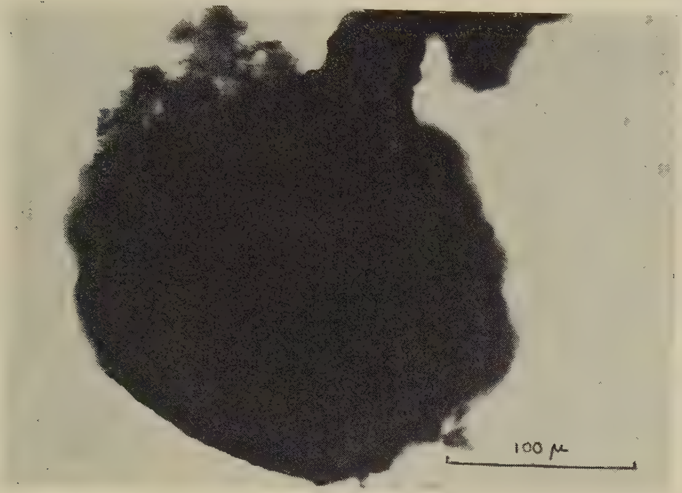

Fig. 7. *Microascus trigonosporus* Emmons & Dodge
Perithecium discharging a cirrhus of ascospores

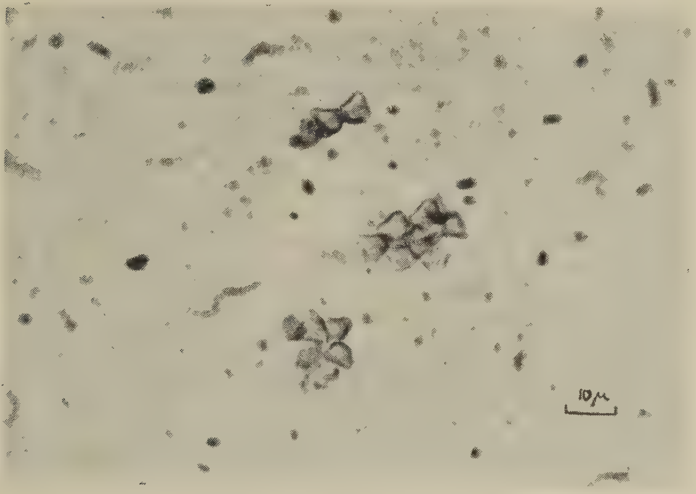

Fig. 8. *Microascus trigonosporus* Emmons & Dodge
Ascospores

CHAETOMIACEAE.

(Some *Chaetomia* isolated by S. Borut could not be identified by us with certitude, so we took the liberty to send 18 slides of these isolates to Dr. J. Walton Groves, Ottawa, who kindly examined our material and classified it into two species (sensu lato): *Ch. gangligerum* Ames and *Ch. succineum* Ames. According to his opinion the morphological differences of our isolates are too inconspicuous to justify the creation of a new species. Further cultural studies could be of great taxonomic interest).

65. *Chaetomium gangligerum* Ames.
Isolated by S. Borut from loess-soil at the depths of 10, 25 and 35 cm: Mishmar Hanegev, September and December, 1953, April and November, 1954; from loess-soil at the depths of 10 and 45 cm: Beersheba, September and December, 1953, November, 1954; from sandy soil at the depths of 10 and 25 cm: Tureiba, September, 1953, March, 1955: from Hammada soil at the depths of 15 and 30 cm: 12 km to Sdom, December 1953, and April, 1954.

Colonies gray; perithecia black-brown, elliptic to globose, 80—145 × 70—130 μ; lateral hairs smooth, septate, straight or slightly flexed, 2,5—3,8 μ thick; terminal hairs 2,5—4,4 μ thick, septate, roughened, straight at their base, spirally coiled above, with 5 to 16 turns; asci club-shaped, 30—35 × 11 μ, evanescent; ascospores grayish-brown, elliptical, sometimes with oil droplets, 11—17 × 7—9 μ, black in mass.

66. *Chaetomium globosum* Kunze = *Ch. setosum* Bainier = *Ch. subterraneum* Swift & Povah.
Isolated by N. Stibel from desert soil beneath *Salsola tetrandra*, at the depth of 25 cm: Judaean Desert, 37 km on the Jerusalem-Jericho road, April, 1947.

Perithecia broadly ovate, 100—300 × 100—250 μ, thickly clothed with long (up to 350 μ), flexuous, light brown hairs 2,5—4 μ in diameter, with encrusted walls; terminal hairs somewhat coarser, simple; asci evanescent, 36—38 × 30 μ; ascospores dark, 10—15 × 7—10 μ, apiculate at both ends. The shape and the dimensions of our asci do not agree with those given by Sabet (1937) for the same species isolated from soil in Egypt (60 × 13 μ). Moreover, our ascospores are somewhat larger than indicated in Skolko & Groves (1953, p. 794): 8—9,5 × 6—8μ

67. *Chaetomium spirale* Zopf.
Isolated by N. Stibel from desert soil, beneath *Chenolea arabica*, at the depth of 25 cm: Judaean Desert, 21 km on the Jerusalem—Jericho road, May, 1947.

Colonies brown-deep green, perithecia 250—350 × 130—200 μ; globose or ovate, with a few rhizoides on their base; lateral hairs septate, dark-brown, roughened, slightly flexed, 2,5—4 μ at their base, becoming smooth, pale yellow and tapering towards the 1,5 μ thick tip; terminal hairs 2,5—5 μ, spirally coiled, with 8—10 and as many as 14 turns; asci rapidly evanescent; ascospores olive-brown, 9—12 × 7—8 μ.

68. *Chaetomium succineum* Ames.
Isolated by S. Borut from loess-soil, at the depths of 10 and

25 cm: Beersheba, December, 1953, April, 1954; from sandy soil at the depths of 50 cm: Tureiba, December, 1953; from Hammada soil at the depths of 15 and 30 cm: 12 km to Sdom, December, 1953, April, 1954.

Colonies olive-green to yellowish-gray; perithecia dark brown, globose to elliptical, 100—190 × 80—130 μ; lateral hairs brown, roughened, septate, straight, tapering towards the apex, 2,5—4,5 μ thick; terminal hairs 2,2—4 μ in diameter, brown, roughened, septate, loosely coiled and twisted; some strains have 3—4 spirals towards the apex; asci club-shaped, 40—45 × 11—16 μ, evanescent; ascospores dark-gray, elliptic to elongated, 10—15 × 5,5—9 μ.

HYPOCREACEAE.

69. *Hypomyces rosellus* (ALB. & SCHWEIN.) TUL.
Conidial form: *Dactylium dendroides* (BULL.) FRIES.
Isolated by A. ZONENSCHEIN and M. GOLDZWEIG from humus-soil, beneath *Pinus halepensis*, in the gardens of the Hebrew University: Jerusalem, December, 1945.

Stroma felt-like, rose-reddish; perithecia partly sunken; 350—380 × 280—300 μ; asci 125—150 × 6—7 μ; ascospores two-celled, 27—32 × 5—6 μ, with crooked appendages at the tips.

The conidial form, *Dactylium dendroides*, has septate conidiophores branched verticillately; conidia elongate, hyalin, with 3 septa, 27—38 × 10—13 μ.

The Fungus has been isolated in the conidial form, and after 30 days on Czapek's medium, the typical stroma and young perithecia have been formed.

XYLARIACEAE.

70. *Rosellinia winteriana* SPEG.
Isolated by S. BORUT from Hammada soil at the depth of 15 cm: 12 km to Sdom, December, 1953.

Colony gray, spreading; perithecia black, subglobose or oval, 180—200 × 400 μ, with brown-black smooth walls; base of the perithecium submerged in a subiculum; asci elongate, stipitate, sterile part 60 μ long; fertile part 80—85 × 10—11 μ; paraphyses thread-like, 4 μ wide; ascospores fusiform, dark-brown, smooth-walled, 14—18 × 7—10 μ. Oil droplets present in young ascospores.

III. DEUTEROMYCETES

SPHAERIOIDACEAE.

71. *Coniothyrium rude* BUBAK.
Isolated by S. BORUT from Hammada soil at the depth of 10 cm: 22 km to Sdom, December, 1953.

Colonies at first white, floccose, becoming black with the development of the black pycnidia; pycnidia spherical, 100—230 μ in diameter; peridium black, pseudoparenchymatic; conidia 8,4—11 × 6,4—8,4 μ, elliptical, brown.

This species was isolated by BUBAK (1914) from dry stems of *Astragalus spinosus* on the coasts of Arabia and in arid zones in Mesopotamia.

72. *Coniothyrium subcrustaceum* BUBAK.
Isolated by S. BORUT from loess-soil at the depth of 10 cm: Beersheba, March, 1955.

Colonies gray; pycnidia black, globose, 90—130 μ in diameter; peridium pseudoparenchymatic; conidia 7—9 × 5,6—7 μ, elliptic, brown, sometimes hyalin.

This species was isolated by BUBAK (1914) in Mesopotamia on branches of *Zizyphus nummularia.*

According to BUBAK (1914) species of *Coniothyrium* found in arid zones are distinguished by bigger conidia.

73. *Phoma hibernica* GRIMES, O'CONNOR & CUMMINS.
Isolated by A. KRUGLIAKOV from calcareous soil, beneath *Pinus halepensis* at the depth of 15 cm, in gardens of the Hebrew University, Jerusalem, February, 1946.

Pycnidia 100—150 × 82—112 μ, with 1 to 3 ostioles; spores hyalin, pink in mass, 5,6 × 3—3,5 μ; dark chlamydospores present.

(Two other species of *Phoma* and one species of *Sphaeronema* were isolated by S. BORUT but have not been identified as yet).

MUCEDINACEAE.

74. *Cephalosporium acremonium* CORDA.
Isolated by S. BORUT from sandy dune soil at the depths of 10 and 50 cm: 12 km south of Beersheba, September and December, 1953; from sandy soil at the depth of 50 cm: Tureiba, April, 1954; from loess-soil at the depth of 25 cm: Mishmar Hanegev, November, 1954; from Hammada soil at the depth of 20 cm: 22 km to Sdom, March, 1955.

Colonies floccose, white, becoming pale-rose coloured with age; conidiophores 40—50 × 3 μ, erect, simple; heads spherical; conidia hyalin, elongate or elliptical, sometimes curved, 3—5 × 1—2 μ.

75. *Cephalosporium asperum* MARCHAL.
Isolated by S. BORUT from loess-soil at the depth of 10 cm: Mishmar Hanegev, March, 1955.

Colony floccose, gray; conidiophores straight, simple, 15—30 × 1,5—2 μ; heads spherical; conidia 4,5—6 × 3,2—4 μ; elliptic to oval, hyalin, asperulate.

76. *Cephalosporium curtipes* SACCARDO.
Isolated by D. RIJIK from field soil beneath *Hordeum* at the depth of 15 cm: Jerusalem, April, 1947; by S. Borut from loess-soil at the depth of 10 cm: Beersheba, November, 1954.

Colonies white, floccose; conidiophores 10—25 × 2—3 μ, short, simple; conidial heads spherical; conidia hyalin, elongate, 8—10 (14) × 2,5—3,8 μ.

77. *Cephalosporium humicola* OUDEMANS.
Isolated by S. BORUT from sandy dune soil at the depth of 50 cm: 12 km south of Beersheba, December, 1953; from loess-soil, at the depths of 25 and 35 cm: Mishmar Hanegev, April, 1954.

Colonies floccose, white, becoming pale-rose with age; chlamydospores appearing in the vegetative hyphae; conidiophores 50—150 μ long, erect, simple; heads spherical, 15—30 μ in diameter; conidia 2,2—3 μ, globose, hyalin.

(*Dactylium dendroides — see* 69. *Hypomyces rosellus*).

78. *Sepedonium latericium* BRES.
Isolated by T. RAYSS from humus soil, beneath *Quercus calliprinos*: Aqua-Bella near Jerusalem, January, 1944.

Sterile hyphae 4—5 μ wide, septate; conidia globose, echinulate, rose coloured, 5—7 μ in diameter, forming a brick mass, which becomes violaceous when dry.

79. *Spicaria violacea* ABBOTT.
Isolated by S. BORUT from loess-soil at the depth of 35 cm: Mishmar Hanegev, September, 1953.

Colonies white, floccose, loose textured, 2 mm deep, not becoming violet when mature; reverse colourless at first, then yellow; conidiophores 20 × 2,5—3 μ, monoverticillate, arising in whorls upon aerial hyphae; sterigmata few, divergent, 8—10 × 2 μ, tapering towards the apex; conidia 2,8—3 × 2,2—2,5 μ, hyalin, smooth, elliptical, with pointed ends, in long loose chains.

Our isolate may be a white mutant of this species.

80. *Tritirachium album* LIMBER.
Isolated by S. BORUT from Hammada soil at the depth of 30 cm: 12 km to Sdom, September, 1953.

Colonies white, floccose; reverse yellowish-orange; vegetative hyphae branched, septate, 2,5—3 μ thick; conidiophores upright, long, slender, branches solitary or in whorls of 2 to 4, forming 70°—90° angle with the conidiophore, sterile portion 15—25 μ long, tapering to a rachis-like, zig-zag, conidia bearing portion, 20—25 μ long; conidia hyalin, globose or ovoid, 2,1—3 × 2—2,5 μ borne apically or laterally on little spines.

81. *Verticillium glaucum* BONORDEN.
Isolated by N. STIBEL from soil on the bank of the Alexander river, at the depth of 25 cm: Kefar-Vitkin, February, 1947.

Colonies blue-green; conidiophores 75—100 × 3 μ erect, twice verticillately branched; conidia globose, 2,5 μ in diameter.

DEMATIACEAE

82. *Alternaria chartarum* PREUSS.
Isolated by T. RAYSS from soil beneath *Pinus halepensis* at the gardens of the Hebrew University, Jerusalem, April, 1944.

Colony brownish-black; conidia subglobose to elongate, 30 × 12 μ, borne in chains.

83. *Alternaria geophila* DASZEWSKA.
Isolated by S. BORUT from loess-soil at the depths of 10 and 35 cm: Mishmar Hanegev, September and December, 1953; from Hammada soil at the depth of 30 cm: 12 km to Sdom, April, 1954; from loess-soil at the depth of 45 cm: Beersheba, November, 1954.

Colonies black green, mycelium up to 1 cm high; reverse black; conidia 15—35 × 7—14 μ, smooth, brown, borne in short chains; each conidia cell contains a fat globule.

84. *Alternaria grisea* SZILVINYI.
Isolated by S. BORUT from saline soil at the depth of 50 cm: 2 km north of Sdom, November, 1954.

Colonies brown; conidia 17—25 × 8—15 μ, smooth, bright brown, globose to piriform.

85. *Alternaria humicola* OUDEMANS.
Isolated by N. STIBEL from soil, beneath *Prosopis farcta*, at the depth of 25 cm: Beith Hashitta, September, 1945; by S. Borut from loess-soil at the depth of 10 cm: Mishmar Hanegev, December, 1953; from Hammada soil, at the depth of 20 cm: 22 km to Sdom, April, 1954.

Colonies black-green; sterile hyphae 3—5 μ wide; conidia 15—60 × 10—15 μ, 3 to 7 times septate, non-constricted at the septa, dark brown, finely roughened at maturity; borne in long chains.

86. *Alternaria tenuis* NEES.
Isolated by S. BORUT from loess-soil at the depth of 10 cm: Mishmar Hanegev, April, 1954; from Hammada soil at the depth of 30 cm: 12 km to Sdom, date as above; from loess-soil at the depth of 45 cm: Beersheba, November, 1954.

Colonies olive-green, becoming black with age; reverse black; conidia 13—35 × 8—15 μ, bright brown when young, dark brown at the maturity, with roughened walls, constricted at the septa.

87. *Botryotrichum piluliferum* SACC. & MARCH. = *Coccospora agricola* GODDARD.
Isolated by S. BORUT from sandy dune soil at the depth of 50 cm: 12 km south of Beersheba, December, 1953.

Colonies white; reverse light tan; aleuriospores acrogenous, globose, 13,2—15,4 μ in diameter, walls 1,5—2,5 μ thick, yellow; borne singly or in clusters upon branched hyphae.

Sterile hairs and phialospores have not been found in our isolate, but according to DOWNING (1953, p. 937) they are "present in all collections from natural substrata, but not always found in culture".

88. *Hormodendrum cladosporioides* (FRES.) SACC.[1]
Isolated by N. STIBEL from sandy dune soil at the depths of 10 and 50 cm, beneath *Artemisia monosperma*, *Lotus creticus* and *Agropyrum junceum*: Nathaniya, December, 1946; by S. BORUT from sand dune soil at the depths of 10 and 25 cm: 12 km south of Beersheba, September, 1953; from Hammada soil at the depth of 30 cm: 12 km to Sdom, November, 1954.

Colonies dense, olive-green when young, becoming gray-black at maturity; reverse black; conidiophores 170—250 × 3—5 μ, erect, septate, branched; conidia 3—6,5 × 2,2—4 μ, elliptic, smooth, olive-brown.

89. *Hormodendrum hordei* BRUHNE.
Isolated by S. BORUT from loess-soil at the depths of 10, 25 and 35 cm: Mishmar Hanegev, September and December, 1953, November, 1954; from Hammada soil at the depth of 35 cm: 22 km to Sdom, November, 1954.

Colonies dense, olive-green when young, becoming brown to brown-black with age; conidiophores 50—100 × 3—5 μ, erect, brown, septate; conidia 5—16 × 3—5μ, elliptic, oval or elongate, developing single septum, becoming verrucose with age and borne in short chains.

90. *Hormodendrum nigrescens* PAINE.
Isolated by S. BORUT from Hammada soil at the depth of 10 cm: 12 km to Sdom, November, 1954.

Colonies at first olive-black, becoming gray with age; reverse black; sterile white hyphae arising above the conidiophores; conidiophores 300 × 4—7 μ, erect, branched; conidia 4—10 × 3—4 μ, green-brown, elliptical.

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[1] According to VIENNOT-BOURGIN & FERNIER (1950) the genus *Hormodendron* is in reality a culture form of *Cladosporium*.

91. *Hormodendrum olivaceum* (CORDA) BONORDEN.
Isolated by S. BORUT from sandy soil at the depths of 10 and 25 cm: Tureibe, November, 1954, March, 1955.

Colonics olive-green, margins white; conidiophores 100—200 × 3—5 μ, erect, septate, branched at the apex; conidia 7—14 × 4—5 μ, elliptical or subglobose, in short chains.

92. *Hormodendrum resinae* LINDAU.
Isolated by S. BORUT from loess-soil at the depth of 10 cm: Beersheba, September, 1953 and November, 1954.

Colonies floccose, dark brown; conidiophores 180—330 × 3—4 μ, erect, septate, branched at the apex; conidia 5—9 × 3,5—5 μ, brown, transparent, elliptical, finely verrucose.

93. *Hormodendrum viride* (FRES.) SACC.
Isolated by S. BORUT from sandy dune soil at the depth of 25 cm: 12 km south of Beersheba, April, 1954; from sandy soil at the depth of 10 cm: Tureiba, March, 1955.

Colonies compact, gray-green; conidiophores 90—100 × 2—4 μ, erect, septate; conidial chains short, sometimes dichotomously branched; conidia 5—13 × 2—4,5 μ, elongate or oval, green-brown, smooth, frequently with oil droplets.

94. *Nigrospora sphaerica* (SACC.) MASON.
Isolated by N. STIBEL from sandy dune soil at the depth of 25 cm: beneath *Artemisia monosperma*: Nathaniya, November, 1946.

Sterile and fertile hyphae creeping; becoming dark with age, much branched; conidia 15—17,5 μ in diameter, shiny, black, smooth.

95. *Periconia pycnospora* FRES. forma *israelitica* RAYSS & BORUT f. nov. A typo differt conidiophoris minoribus et conidiis majoribus.
Isolated by S. BORUT from loess-soil at the depth of 45 cm: Beersheba, March, 1955.

Vegetative mycelium hyalin; conidiophores about 140 × 5—8 μ (according to the diagnosis: 200—300 × 10—14; according to CL. and M. MOREAU (1951): 350 × 8—15 μ); erect, with brown walls and 2 to 3 septae, branched at the apex; conidial chains arising from sterigmata on apical branches; conidia 18—23 μ in diameter (according to the diagnosis: 12—17 μ; according to CL. and M. MOREAU (1951): 10—20 μ), brown-black, smooth when young, becoming strongly verrucose at maturity.

96. *Spondylocladium xylogenum* A. L. SMITH.
Isolated by D. RIJIK from cultivated soil at the depths of 10 and 15 cm, beneath *Trifolium alexandrinum*: Gheva, May, 1947; by M. KATZ from cultivated soil: Mikveh-Israel, January, 1953.

Colonies black-green, reverse black; conidiophores 60—200 μ long, septate, dark-coloured, geniculate; conidia 10—20 × 8—11 μ, three-septate, slightly curved, borne terminally and laterally.

97. *Stachybotrys atra* CORDA (Fig. 9).
Isolated by S. BORUT from loess-soil at the depths of 10, 25 and 35 cm: Mishmar Hanegev, September and December,

1953, April and November, 1954, March, 1955: from loess-soil at the depths of 10, 25 and 45 cm: Beersheba, September, 1954 and April, 1954; from sandy dune soil at the depth of 25 cm: 12 km south of Beersheba, September, 1953; from sandy soil at the depths of 10, 25 and 50 cm: Tureiba, September and December, 1953.

Colonies black; reverse black; conidiophores 50—80 × 2—3 μ, septate, with brown walls, arising from dark mycelium, with branches almost at right angles; phialides 8—10 × 3,5—5,5 μ, elliptical; conidia 8—11 × 4,5—7 μ, elliptical, pale gray and smooth when young, becoming black and somewhat verrucose with age.

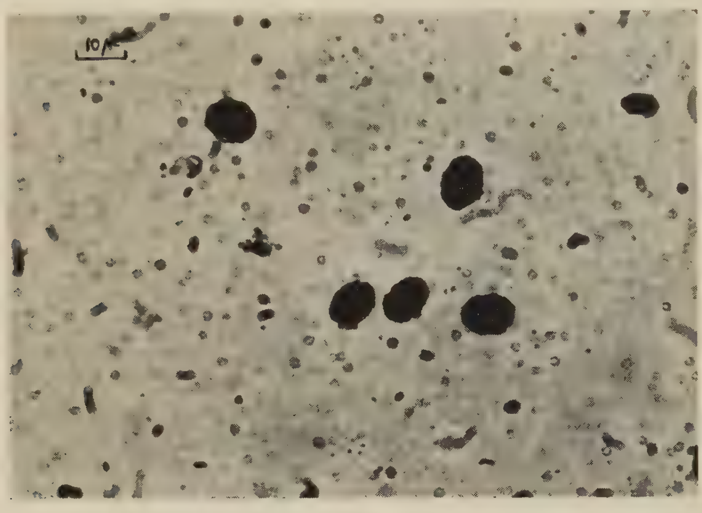

Fig. 9. *Stachybotrys atra* CORDA
Conidia

97b. *Stachybotrys atra* CORDA, var. *cylindrospora* RAYSS & BORUT comb. nov. = *S. cylindrospora* JENSEN (Fig. 10).
Isolated by S.BORUT from loess-soil at the depths of 25 and 45 cm: Beersheba, September, 1953.

Conidiophores 40—70 × 2,5—3,5 μ; phialides 8—11 × 3,5—4,5 μ; conidia 9—11 × 2,5—5 μ.

Differs from a typical *Stachybotrys atra* mainly by the conidia which are cylindrical and thinner than in the type.

98. *Stemphylium verruculosum* ZIMMERMAN = *Stemphylium consortiale* (THUM.) GROVES & SKOLKO.
Isolated by S. BORUT from loess-soil at the depths of 10, 25 and 35 cm: Mishmar Hanegev, September, 1953 and April, 1954; from loess-soil at the depth of 10 cm: Beersheba, November, 1954 and March, 1955; from sandy soil at the depth of 50 cm: Tureiba, March, 1955; from Hammada soil at the depth of 35 cm: 22 km to Sdom, November, 1954.

Conidial areas at first olive-green, becoming black with age; reverse black; conidiophores 3—5 μ wide, septate, with brown walls; conidia 15—30 × 10—17 μ, oval, elliptic or elongate, muriform, at first brown, smooth, becoming black and verrucose with age.

Conidia of the isolate from Mishmar Hanegev, depth of 35 cm, are more or less globose and correspond perfectly to the figure of *S. consortiale* (Groves & Skolko, 1944, plate V).

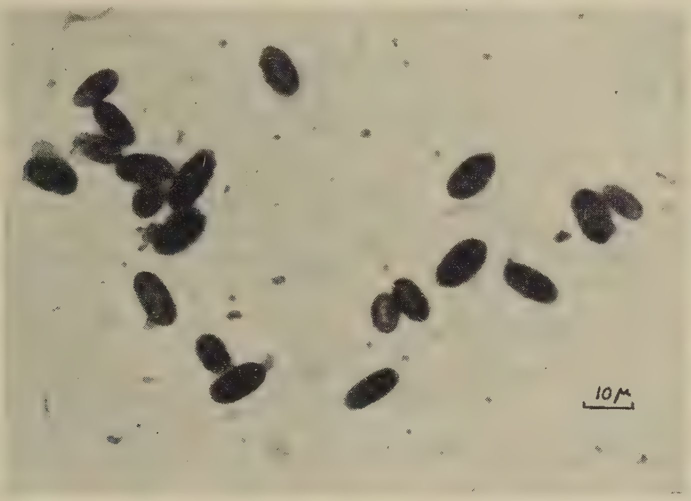

Fig. 10. *Stachybotrys atra* Corda var. *cylindrospora* Rayss & Borut
Conidia

99. *Torula lucifuga* Oudemans.
Isolated by S. Borut from sandy soil at the depth of 50 cm: Tureiba, September, 1953.

Colonies at first yellowish, becoming gray with age; reverse black, almost all hyphae divided into chains of conidia by numerous septa; conidia 12—17 × 7—8,4μ, globose, ellipsoid or elongate, gray-green, with smooth walls and granular interiors.

100. *Zygodesmus* sp.
Isolated by S. Borut from sandy soil at the depth of 25 cm: Tureiba, December, 1953.

Mycelium delicate, hyalin; conidia 4,5—7 μ in diameter, black, globose, with thick walls and obvious spines, borne laterally on the hyphae.

STILBACEAE

101. *Styzanus cybosporus* D. Sacc.
Isolated by A. Krugliakov from soil in the gardens of the Hebrew University: Jerusalem, January, 1945.

Coremia formed by green-brown hyphae, 5—7 up to 10 μ broad; stalks 1,2 mm high, 100—200 μ in diameter at their base, broadening towards the apex to 700—1500 μ; conidia hyalin, cuboid, 6 μ in diameter.

102. *Stysanus medius* Sacc. = *Stysanopsis media* (Sacc.) Ferr.
Isolated by S. Borut from loess-soil at the depth of 35 cm: Mishmar Hanegev, September, 1953.

Coremia black, scattered; stalks 300—460 × 10—25 μ, built of parallel, brown, septate hyphae, 2,8—3 μ broad; conidia 4,5—5,6 × 3 μ, elliptical, smooth, pale-green, borne in chains and forming a narrow grayish head.

The coremia of our isolate are narrower than in the diagnosis (30 μ in diameter), but Lindau (1910, p. 378) reports that the coremia of his isolates have been only 23—27 μ thick.

103. *Tilachlidium humicola* Oudemans.
Isolated by S. Borut from loess-soil at the depth of 35 cm: Mishmar Hanegev, November, 1954; from loess-soil at the depths of 10, 25 and 45 cm: Beersheba, April, November, 1954 and March, 1955.

Colonies floccose, at first white, becoming grayish with age; coremia white, cylindrical, 20—50 μ wide, secondary branches 35—60 μ long; conidia bound together into a spherical head, 15—20 μ in diameter, at first slimy, later dry; conidia 5—7 × 3,5—5 μ, elliptical, bright-green.

TUBERCULARIACEAE

104. *Fusarium dianthi* Prill. & Delacr.
Isolated by S. Perelmutter from soil beneath *Dianthus caryophyllus*, in the gardens of the Hebrew University: Jerusalem, October, 1936; by I. Wahl, Ein Harod, June, 1936.

Fructifications appearing as *Cylindrophora* and forming a white aerial mycelium and also as typical *Fusarium* in slimy, bright orange-coloured sporodochial masses.

105. *Fusarium orthoceras* App. & Wr.
Isolated by L. Gherson from cultivated soil beneath *Fragaria elatior*: Jerusalem, July, 1941.

Aerial mycelium white, cottony; microconidia 10—16 μ long, in false heads, ellipsoid, non-septate; macroconidia 16—31 μ long, sickle-shaped, 1 to 3 septate, in slimy, brownish-white sporodochia; chlamydospores single or in chains, round, unicellular.

106. *Myrothecium roridum* Tode.
Isolated by S. Borut from Hammada soil at the depth of 30 cm: 12 km to Sdom, September, 1953.

Sporodochia irregular in shape, dark green when young, becoming black with age, 2—6 mm in diameter, forming concentric rings; conidiophores 30—40 × 2 μ, erect, unbranched; conidia 8—9 × 1,8—2 μ, hyalin, cylindrical, truncated at both ends.

107. *Myrothecium verrucaria* (Albertini & Schweinitz) Ditmar = *Metarrhizium glutinosum* Pope.
Isolated by S. Borut from loess-soil at the depth of 10 cm: Mishmar Hanegev, April, 1954.

Aerial mycelium wooly, white; sporodochia green at first, becoming black with age; conidiophores 50—75 × 2—2,5 μ, branched in whorls, forming a palisade like layer; conidia 7—7,5 × 2,5—3 μ, pale-green, elongate with two oil-droplets at both ends, formed in chains.

MYCELIA STERILLA

Many forms of Mycelia sterilia belonging to the genera *Rhizoctonia*, *Sclerotium* and others, have been isolated by us from different soils without being definitively identified.

Isolates of Actinomycetes from different soils, have been sent to Prof. Baldacci, Milano, and have been identified by him as belonging to the genus *Actinomyces*, series: *Albus*, *Aureus*, *Diastaticus*, *Rimosus* and *Viridis*. The results of this research work have been published (Baldacci, Balduzzi & Amici, 1957).

Summary and Conclusions

This study deals with 107 species of Fungi, 21 of which belong to the Phycomycetes, 49 to the Ascomycetes and 37 to the Fungi imperfecti, isolated from different soils of Israel.

The majority of the Phycomycetes have been isolated from cultivated soils, a relationship which no doubt tallies with the high amount of organic matter (especially sugars), always found in these soils.

Among the Ascomycetes, Penicillia and Aspergilli prevail, especially in arid zones. Many species of these two genera produce sclerotia or perithecia.

In addition, some species of *Chaetomia* which decompose cellulose strongly are also common.

Of special interest are representatives of the Gymnoascaceae isolated from the arid soils.

Among the Fungi imperfecti, a few species of Sphaerioidaceae have been isolated. These are generally plant-pathogens and no doubt were introduced into the soil together with the host plants, whose residues soon vanish, making identification often impossible. To this category belong two species of *Coniothyrium*, described by Bubak (1914), on desert plants from Mesopotamia and Arabian deserts.

Of the Fungi imperfecti only eight species belong to the Mucedinaceae, the remainder to Dematiaceae, Tuberculariaceae and Stilbaceae — families with more resistant forms.

Three new forms are described:

Actinomucor corymbosus (Harz) Naumov forma *palaestina*

Thielavia terricola (Gilman & abbott) Emmons forma *minor*

Periconia pycnospora Fres. forma *israelitica*

Among the Aspergilli two reduced froms have been found and described.

Among the Fungi isolated by us, eleven are apparently new to soils, not being recorded by GILMAN (1957) and in later publications dealing with this subject. They are: *Circinella nigra, Eidamella deflexa, Myxotrichum emmonsii, Chaetomium gangligerum, Ch. succineum, Rosellinia winteriana, Coniothyrium rude, C. subcrustaceum, Sepedonium lateritium, Alternaria chartarum, Styzanus cybosporus.*

The following sixteen species are rare in soils and have been isolated only once or twice: *Mucor ambiguus* isolated in Michigan, *M. griseo-lilacinus* isolated in Illinois, *M. prainii* isolated in Jugoslavia, *Cunninghamella bainieri* not indicated by GILMAN 1957, but isolated from soil in France (LING-YOUNG 1930), *Penicillium multicolor* not indicated by GILMAN 1957, but isolated from soils in Russia and U.S.A. (RAPER & THOM 1949, p. 200), *P. ochrochloron* not indicated by GILMAN 1957, but isolated from soil in Australia (McLENNAN & DUCKER 1954), *Microascus trigonosporus* not indicated by GILMAN 1957, but isolated from soil in El Salvador (ROUTIEN 1957), *Hypomyces rosellus* (indicated by GILMAN as *Dactylium dendroides*, only from Canada), *Phoma hibernica* isolated in Canada, *Cephalosporium asperum* isolated in U.S.S.R., *Alternaria grisea* isolated in Sumatra, *Hormodendrum nigrescens* isolated in Iowa (U.S.A.), *H. resinae* isolated in Austria, *Periconia pycnospora* not indicated by GILMAN 1957, but isolated from soil in France (MOREAU, Cl. et M. 1951), *Tilachlidium humicola* isolated in Holland, *Tritirachium album* not indicated by GILMAN 1957, but isolated from soil in France (MOREAU, Cl. et M. 1951).

On comparing the Israeli data with those of Egypt, we find that twenty three species are common to the soils of both countries (especially species of Mucorales and Aspergilli): *Absidia glauca, A. spinosa, Actinomucor corymbosus, Mucor griseo-cyanus, M. hiemalis, M. mucedo, Rhizopus nigricans, Cunninghamella echinulata, Aspergillus flavipes, A. flavus, A. niger, A. ochraceus, A. terreus, A. ustus, A. versicolor, A. wentii, Penicillium citrinum, P. egyptiacum, Chaetomium globosum, Verticillium glaucum, Alternaria geophila, Hormodendron cladosporioides, Stachybotrys atra.*

Special attention ought to be given to *Penicillium egyptiacum* VAN BEYMA, described first from Egypt soil in 1933. This species has since been isolated by many workers and is believed to be cosmopolitan in distribution. In Israel it is very common in the arid zones.

Noteworthy to mention is the apparent absence of *Trichoderma* in the soils of Israel investigated by us, and in those of Egypt. This genus is known to be very common in acid soils.

The following species are common to the soils of Israel and the Sahara: *Mucor mucedo, M. racemosus, Rhizopus nigricans, Gymnoascus reessii, Aspergillus flavus, A. fumigatus, A. niger, A. ochraceus,* *A. terreus, Penicillium frequentans, Cephalosporium acremonium, Alternaria tenuis.*

Of the above, *Aspergillus fumigatus* and *A. terreus*, are of special interest because of their thermophilic nature.

Acknowledgements

The authors wish to express their thanks to Dr. J. Walton Groves (Ottawa) for the identifications of *Chaetomium*, to Prof. E. Baldacci (Milano) for his extensive study of the Actinomycetes, isolated from the soils of the Northern Negev and to Dr. A. Borut for preparing the photomicrographs for this Contribution.

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LIBRI NOVI

ANSEL, M: *Mycoses et Champignons Parasites de l'Homme.* One volume, in-8. 345 pages, 107 figures. Paper. G. Doin & Co. Paris (VIe)., 1957. Price: 2,500.— Frs.

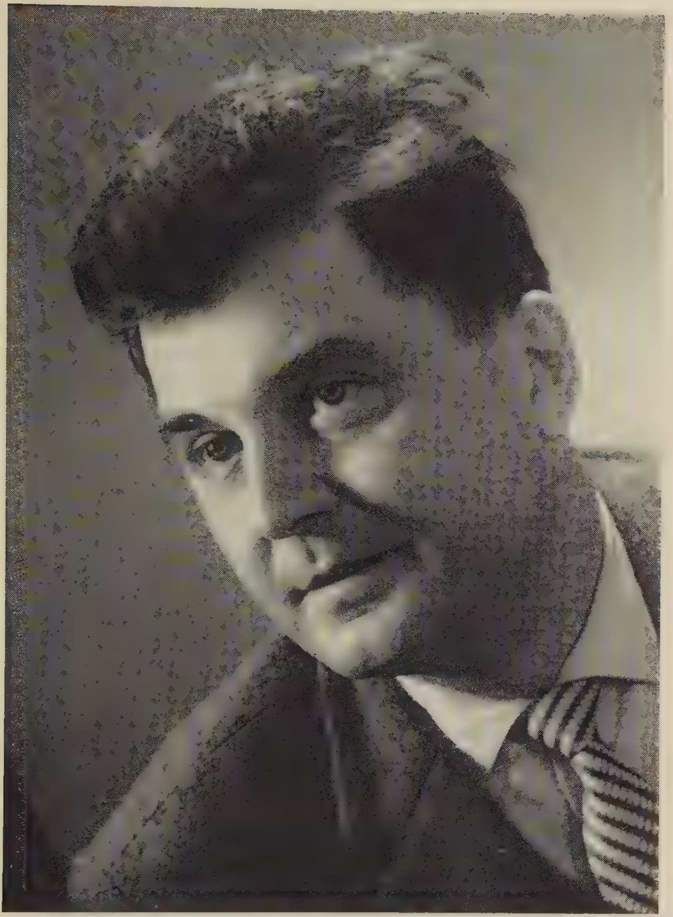
The author, one of the school of LANGERON, undertook an ambitious work to write another text, among many other recent ones, on (medical) mycology, destined for the use of medical men and medical students. The general introduction into the basic knowledge of mycology (form elements, organs of reproduction, etc.) is covered only on fifteen pages. The rest is taken up by the discussion of fungous diseases and their causative organisms. At each disease entity he systematically discusses the morphology, physiology, geographic distribution, topology (habitat of the fungus), symptomatology of the specific infection, histopathology of the lesions, diagnostic, treatment and the technic of investigation. Every chapter is closed by a short, selected bibliography. So far, this is, indeed, an original and worth-while form of presentation of the material.

At closer scrutiny, however, this text has many serious shortcomings. The author apparently follows the present trend among mycologists (a deleterious conformism!) to put "candidiasis" as something "new" in the center of their interest. This trend may be characterized by lack of first hand knowledge of the dermatologic entities with their great clinical diversities and by the sheer ignorance of the clinic, histopathology, etc. "Candidiasis (a few years ago it was "moniliasis" but the "name of the firm" after total bankrupcy was changed with exactly the same hodge-podge clinical contents!) is simply based on the wrong idea that a microorganism is the "causative" agent by its sheer presence and by the simple fact that it can be obtained in pure culture from any detritus mass. Pure culture of any fungi is no evidence in itself for its etiologic role. Under "candidiosis" the author presents, as evidence, photographs of nummular eczema (manifestation of vitamin A deficiency), typical cases of seborrheic dermatitis, classical forms of pompholyx of the fingers and toes, "candidiose interdigitale" (previously: erosio interdigitalis blastomycetica). These samples of complete confusion may suffice.

The second most serious objection of the reviewer concerns the author's nomenclature. The reviewer took a stern stand, back in 1948, as to the creation of newer and newer nomenclatures which, except for their author, no reasonable teacher of medical mycology would use. So we find *Madurella mycetomi* grouped under "Adélomycètes, A. Aphyosporés". Since we have already "*Sabouraudites*" (disguising *M. audouini, canis,* etc.), the author as a pupil of Langeron apparently felt the urge to introduce a new nomenclature for the Trichophytons under "*Langeronites*". The term "fuseau" well understood the world over, was replaced by the new term "atractospores".

The illustrations are satisfactory. The bibliographies are fairly well selected. The English language literature is well covered, the German contributions only poorly and the important and rich Italien literature is apparently unknown to the author. Beside the wholly unnecessary, newly created nomenclature and particularly due to the — by now — inexcusable clinical errors and confusions, this text cannot be recommended as an introductory text into medical mycology to anybody.

T. Benedek



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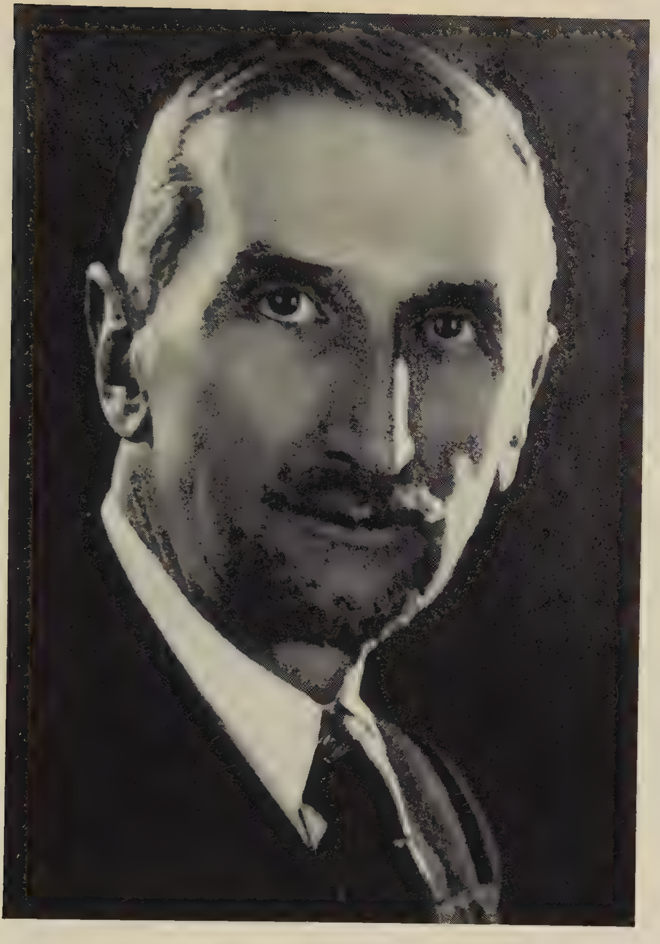

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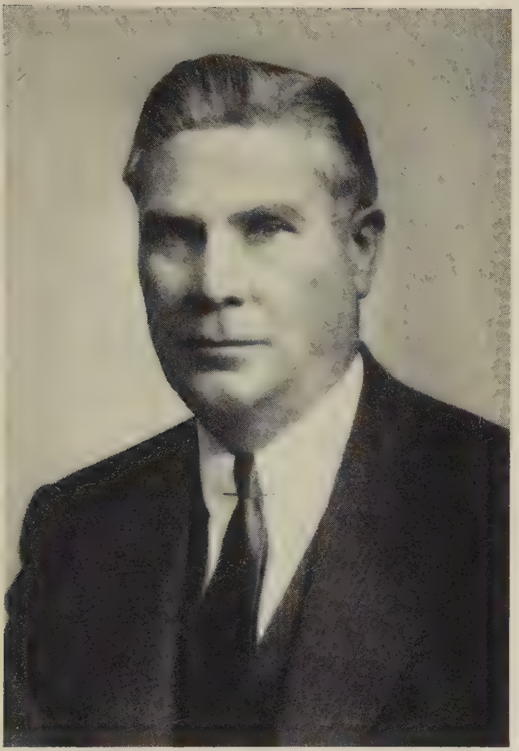

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STUDIES IN MEDICAL MYCOLOGY

I. ON THE OCCURRENCE OF MYCOTIC DISEASES IN LUCKNOW

By

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(4.VII.1958)

Introduction

Considerable work has been done on the clinical aspects of Dermatomycoses and other superficial skin diseases in several medical centres in India, but the contribution to the knowledge of the occurrence of these diseases in Uttar Pradesh is negligible. A survey of the mycotic diseases was, therefore, undertaken with a view to gain insight into their prevalence in Lucknow and its neighbouring areas.

The work was facilitated by the fact that the Skin Department of King George Medical College, Lucknow, is the most important centre in this region for the treatment of the mycotic diseases and therefore draws patients from all localities within and outside the district which gives a fair cross-section of the distribution of mycotic diseases in this area. The survey was started in 1952 and has been continued since. During this period a large number of pathogens were isolated, cultured and studied which established the occurrence in these areas of almost all known types of mycotic diseases. For example, Candidiasis, Erythrasma, Tinea versicolor which are common representatives of superficial skin diseases and Dermatomycoses caused by three pathogens, *Trichophyton*, *Epidermophyton* and *Microsporum.*

The present paper embodies the survey result of the last three years (1955—1957).

Collection

The materials were collected from the patients coming for treatment to the outdoor of the skin department of King George Medical College. After initial clinical examination by the Dermatologist, Dr. R. N. Gupta, the diagnosed and suspected cases of mycotic infection were handed over to the junior author (S.K.S.) for further investigation, who maintained a detailed and careful record regarding the age, sex, profession, clinical symptoms and other relevant data of the patients, followed by the isolation of the pathogens from the affected area. Photographic evidence was kept for those cases which seemed to be of special interest.

The isolations were made by using usual technique which involved the scraping of the infected tissue in aseptic condition from such parts where the pathogen was in active state of growth and present in purest form.

The position naturally varied according to the type of the lesion. Thus in normal cases the edge of the lesion demarcating the healthy and diseased tissues was utilised. Where the infected area was lacerated (sole and toe-web lesions) scrapings were taken from the unlacerated apparently healthy area round the lesion. In the scalp lesions it was the epilated infected hair roots and scales while in nail infections scrapings from the friable and discoloured areas which were used.

The scrapings thus collected were stored in sterilized tubes and duly plugged. These served as the stock for investigations to ascertain the identity of the pathogens both by direct examination of the growth inside the affected tissues and also by means of cultures in the nutritive media.

Pathogen

Direct Examination: According to the nature of the disease from which isolations were made the scrapings were divided into four different groups — those belonging to dermatomycoses, candidiasis, erythrasma and Tinea versicolor. These were separately investigated by direct examination under microscope for the possible presence of the pathogens in the diseased tissues. For this purpose a very small portion of the scraping was taken from the stock tubes and mounted on a slide in a drop of 10—20 % KOH depending upon the nature of the material. A coverslip was placed on it and the preparation gently heated for clearing. If the material failed to clear more KOH was added and the preparation reheated. The slides were then microscopically examined. When certain scrapings failed to reveal the evidence of the fungus other portions from the same scrapings were similarly treated and examined. Most of the scrapings showed the presence of fungal elements which were characteristic of the diseases from which scrapings were obtained as described below:

Dermatomycoses: (a) Branched mycelial elements which in some instances were broken up into arthospores, (b) Arthospores arranged in parallel rows inside the hair (endothrix type), (c) Arthospores arranged in parallel rows outside the hair (ectothrix type) and (d) Small hyphal bits.

Candidiasis: Numerous small oval thin walled yeast-like cells with occasional mycelial elements and budding cells at point of constriction.

Erythrasma: Short, thin, delicate, branched filaments which readily break up into small bacillary or coccoid forms.

Tinea versicolor: Clusters of thin walled round budding cells along with numerous straight angular fragments of mycelium.

Not all the scrapings examined, however, showed the evidence of fungal elements in the diseased tissues. For example, Erythrasma and Tinea versicolor showed the presence of fungal elements in 90.47 % and 97.36 % of cases respectively. But fairly large percentage was free from fungus both in Candidiasis (33.4 %) and Dermatomycoses (29.75 %). The details are given in table I.

Table I.

Positive fungal evidence in diseased tissues

	Total	Dermatomycoses	Tinea versicolor	Erythrasma	Candidiasis
Total number of cases	450	316	38	21	30
Cases showing fungal evidence	298	222	37	19	20
Percentage . . .	73.58%	70.25%	97.36%	90.47%	66.6%

Culture: Simultaneously with the microscopic examination of the scrapings attempts were made to bring the pathogens in culture. Small portions of the scrapings taken from the stock tubes were inoculated 'in-situ' on Sabouraud's medium in triplicates. These were incubated at 37° C. and examined periodically. The first cultures thus obtained showed the presence of pathogens usually associated with certain bacterial and fungal contaminants. The bacterial contaminants were checked by the addition of penicillin (20 units per ml.) and streptomycin (40 units per ml.) to the medium. This allowed the bacteria-free fungus to grow. The contaminating fungi were eliminated by careful subculture and by subsequent monohyphal or monosporal cultures. The usual contaminants associated with the lesions were *Syncephalastrum*, *Aspergillus*, *Penicillium* and *Phoma*. Besides these there were various species of *Alternaria*, *Fusarium*, *Nigrospora*, *Pleospora*, *Gliocladium*, *Cephalosporium* and mycelia sterila largely as atmospheric contaminants.

All the 405 scrapings were utilised for the isolation of the pathogens in culture irrespective of the fact whether or not portions of these on direct examination under microscope had revealed the presence of fungal elements. Out of these all the 59 scrapings belonging to Erythrasma and Tinea versicolor did not grow in media as also experienced by other workers. From among the rest 155 pure cultures could be obtained which on further detailed examination were found to comprise 139 (89.67 %) Trichophytons, 4 (2.58 %) Epidermophytons and 12 (7.75 %) Candidas showing that overwhelming majority of the dermatophytes belonged to the group of *Trichophyton*. The pure culture of the pathogens thus obtained were kept as stock cultures and utilised subsequently for further studies.

Specific identification: On the basis of preliminary study of cultural and morphological characters on Sabouraud's medium the strains belonging to the genus *Trichophyton* were divided into four species, i.e., *T. rubrum*, *T. mentagrophytes*, *T. tonsurans* and *T. verrucosum*. The last named species, as the literature shows, has not been reported from India and seems to be a new record.

Similar study with the genus *Epidermophyton* showed the presence of only one species *E. floccosum*.

The identifications were confirmed by growing representatives of these species in Sabouraud's medium in identical condition simultaneously with authentic species obtained from C.B.S. Baarn Holland. This was further supplemented by studying the growth characters of each of these species in special nutritive media (Manual of Clinical Mycology p. 334—351) which are known to develop specific distinguishing features such as macroconidia, microconidia, chlamydospore, spiral hyphae and nodular bodies. Results are summarised in table II.

TABLE II.

The cultural features of species of Trichophyton and Epidermophyton

Pathogen	Nutritive media	Characteristic features				
		Macroconidia	Microconidia	Chlamydospore	Spiral hyphae	Nodular body
T. rubrum	Blood Agar base	++	++++	++	—	—
T. mentagrophytes	Sabouraud's	++	++++	++	+	+
T. tonsurans	Polished rice grain	++	+++	++	—	—
	Sabouraud's with thiamine	+	++	++	—	—
T. verrucosum	Sabouraud's with thiamine	—	++	++++	—	—
	Sabouraud's with yeast extract	—	++	+++	—	—
E. floccosum	Sabouraud's	++++	—	+++	—	—

(N.B. The relative abundance of different structures are shown by number of plus signs.)

The table shows that the development of characteristic features of dermatophytes in nutritive media follows the usual trend except the failure of production of macroconidia in the case of *T. verrucosum*.

The growth reactions of representative isolates of genus *Candida* were studied in Sabouraud's broth, Blood Agar base and Corn Meal Agar. These were further confirmed by fermentation reactions in broths (Glucose, Maltose, Sucrose and Lactose) suggested by MARTIN et al (1937). The results of these growth and fermentation reaction studies are given in table III.

TABLE III.

The growth and fermentation reactions of Candida albicans

Media	Growth Reaction
Sabouraud's broth	No surface growth, instead flocculant growth at base.
Blood Agar base	Colonies greyish dull, medium sized to small.
Corn Meal	Branched tree-like hyphae with thick walled round chlamydospores and ball like clusters of budding cells.

Broths	Fermentation Reaction
Glucose	A G
Maltose	A G
Sucrose	A —
Lactose	— —

A G = Acid + Gas
A = Acid

As all the isolates behaved similarly in the fermentation and growth reactions in a manner specific to the *Candida albicans* it was clear that the genus *Candida* was represented by one species only. The relative frequency of the different species among the isolates (155) responsible for the diseases are given in table IV in a consolidated form.

TABLE IV.

Relative frequency of species of Trichophyton, Epidermophyton and Candida.

Sl. No.	Pathogen	Total	Percentage
1	*T. rubrum*	78	50.32 %
2	*T. mentagrophytes*	41	26.45 %
3	*T. verrucosum*	12	7.74 %
4	*T. tonsurans*	8	5.16 %
5	*E. floccosum*	4	2.58 %
6	*Candida albicans*	12	7.74 %

The table IV shows that *T. rubrum* is the most common dermatophyte causing about 50 % dermatomycoses. *T. mentagrophytes* causes about 26 % of dermatomycoses whereas *T. verrucosum* and *T. tonsurans* are less common representing about 8 % and 5 % respectively. *Epidermophyton floccosum* is rather uncommon causing

2.58 % dermatomycoses. *Candida albicans* causes only 7.74 % disease. The trend of relative abundance of the species during each of the three years follows the same pattern as for all the three years combined.

Distribution of mycotic diseases

During the three years of survey isolations were made from 405 cases. Analysed in term of the clinical symptoms the distribution as occurred under different categories of diseases is as given in table V.

TABLE V.

Distribution of different mycotic diseases as found in 405 *patients* (1955—57)

Year	Total No. of cases	Dermatomycoses	Tinea versicolor	Candidiasis	Erythrasma
1955	131	99 (75.57 %)	13 (9.92 %)	12 (9.16 %)	7 (5.34 %)
1956	232	190 (81.89 %)	18 (7.75 %)	15 (6.46 %)	9 (3.87 %)
1957	42	27 (64.28 %)	7 (16.66 %)	3 (7.14 %)	5 (11.9 %)
Total	405	316	38	30	21
Percentage		78.02 %	9.38 %	7.4 %	5.18 %

It will be evident from the table that out of 405 cases 316 cases showed Dermatomycoses, 30 Candidiasis, 21 Erythrasma and 38 Tinea versicolor, showing 78 %, 7.4 %, 5.18 % and 9.38 % of diseases respectively. The occurrence of largest number of dermatomycoses cases is easily understandable since the group embraces three different genera of fungi — *Trichophyton*, *Epidermophyton* and *Microsporum*.

Out of these three genera as determined by the culture experiments in appropriate nutritive media only two were represented in the isolations, *Microsporum* being totally absent. The proportion of *Trichophyton* and *Epidermophyton* was 35 to 1.

The data were further analysed to find out the possible relation of the incidence of the disease with sex, age, parts affected, occupation and seasonal factors. The results are summarised in the table VI.

TABLE VI.

Incidence of disease in relation to sex, age, etc.

Nature of disease	Total No. of patients	Sex		Age			Parts affected				
		Male	Female	Adult (A)	Between 12—20 years (B)	Below 12 (C)	Groins and Genitals	Body	Arm & feet	Nails etc.	Scalp
Mycotic diseases	405	311	94	247	133	25	156	115	88	38	8
Candidiasis . . .	30	11	19	17	3	10	13	—	—	16	1
Ringworm (*Tinea circinata*) . . .	134	114	20	77	54	3	90	23	13	6	2

Sex: Out of the 405 cases studied during 1955—1957 about 77 % were males and 23 % females, the proportion being 3.3 : 1. The gross result of all the three years combined follows the same trend as of each of the years separately. Although the number of male patients was considerably higher than that of the females the percentage of successful isolation of pathogens was approximately same viz. 35 out of 94 (37.2 %) in females and 120 out of 311 (38.5 %) in males. It was found that Candidiasis of vulvovagina in females was very common whereas the infection of male genitals with the same pathogen was rare, the incidence being 92 % and 8 % respectively. Reverse was the dominance of *Tinea circinata* infection of genitals in males (85 %) as compared to very low incidence in females (15 %). Among the various mycotic diseases Candidiasis was the only one more common in females (63 %) than in males (37 %).

Age group: In order to analyse the role of age in the various mycotic infections the patients were divided into three age groups, i.e., (i) A = Adult above 20 years, (ii) B = Boys and girls attaining the age of puberty between 12 to 20 years and (iii) C = Children below 12 years. Mycotic infections in general were dominant in adults (61 %), less prevalent among boys and girls attaining age of puberty (33 %) whereas they were rare among clildren (6 %). It was seen, however, that *Tinea circinata* was slightly more abundant in age group B where 41 % patients showed this infection in comparison with only 31 % among adults. Candidiasis was the only disease which was found to be common among children causing 40 % infection.

Parts affected: All parts of the human body are liable to mycotic infections. The diseases are more common in certain parts of the body, i.e., groins and genitals, general body and arms and feet. It was observed that among 405 patients about 39 % were infected in the region of groins and genitals, 28 % all over the body, 22 % in arms and feet, 9 % in nails, cheek, ear, nose, lips, etc. and only 2 % in the region of scalp.

Occupation: Although mycotic diseases are found distributed among all occupational groups, there are certain diseases which are more prevalent among persons of a particular occupation, e.g. ringworm disease (*Tinea circinata*) was found to be common among motor drivers and mechanics, tailors and labourers, about 43 % of disease occurring among them. Candidiasis of the finger and nails was very common among betel sellers, soda and lemonade factory or shop workers, about 62 % cases were found in the people of this group. Epidermophytosis was somewhat prevalent among farmers, gardeners and people engaged in outdoor field work.

Season: Skin diseases occur throughout the year but they show a remarkable fluctuation in relation to the season. Mycotic diseases are dominant in rainy season (July to September) followed by autumn (October to November) and summer (March to June), the intensity of infection becoming very low to rare in winters (December to February). The relative abundance of disease incidence during the four seasons is about 15 : 4 : 3 : 1 respectively.

Discussion

The skin diseases in India are largely due to *T. rubrum, T. tonsurans, T. violaceum, T. concentricum, T. schoenleini, T. mentagrophytes, T. ferrugineum, T. viannae, E. floccosum, M. Audouini, Nocardia* sp. and *C. albicans*. Among these *T. rubrum, T. violaceum,* and *T. tonsurans,* species of the genus *Trichophyton* and *E. floccosum* the only species of *Epidermophyton* are very common (ACTON & MCGUIRE 1927, 1929; CATANEI 1939; GHOSH, PANJA & DEY 1940; NAIR 1942; DUTTA, MAJUMDAR & BOSE 1955). *T. concentricum* (CASTELLANI 1910), *T. schoenleini, T. mentagrophytes, M. Audouini, Nocardia* sp. and *C. albicans* (DUTTA, MAJUMDAR & BOSE 1955) are relatively less common whereas *T. ferrugineum* (MAPLESTONE & DEY 1939), *T. viannae* (DE-MELLO 1917—1918) are rare. Out of the 12 fungi reported from India five have been isolated in the course of these studies. The fungi which are not represented are *T. violaceum, T. concentricum, T. schoenleini, T. ferrugineum, T. viannae, Nocardia* sp. and *M. Audouini*. Among those species found here *T. rubrum* and *T. mentagrophytes* are more prevalent followed by *C. albicans, T. tonsurans* and *E. floccosum*. The rarely occurring species of *T. ferrugineum* and *T. viannae* have not been obtained at all.

An interesting result is the isolation of a species of *T. verrucosum* on 12 occasions from 3 patients in 1955, 8 in 1956 and only one in 1957. The fungus produces ringworm infection of the glabrous skin of body and seems to be a new record from India.

Trichophyton, the dominant genus which causes 89.6 % of mycotic diseases is mainly represented by two of its species, e.g. *T. rubrum* and *T. mentagrophytes* which cause about 50 % and 26 % diseases respectively. The other two species, *T. tonsurans* and *T. verrucosum* are very poorly represented.

The complete absence of the genus *Microsporum* which is a very common dermatophyte responsible for widespread infection in temperate and cold climate in Europe, U.S.A. and Russia is understandable since *Microsporum* although reported from Tropical countries (Java, Indo-China etc.) is represented in India only by one species *M. Audouini*. But strikingly low percentage of *E. floccosum* which alone is responsible for 60 % infection in Bengal is difficult to explain.

Summary

The paper deals with the survey of mycotic diseases of Lucknow for the years 1955—1957. The material was collected from the outdoor patients of Skin Department of King George Medical College, Lucknow. The patients were clinically examined, the lesions from diagnosed and suspected mycotic cases were utilised for scrapings which were examined under microscope and simultaneously cultured for identification of the causal organisms.

Out of 405 cases studied, 316 were dermatomycoses, 38 Tinea versicolor, 30 Candidiasis and 21 Erythrasma.

Dermatomycotic isolates showed the presence of two genera *Trichophyton* and *Epidermophyton*, the former being in overwhelming majority (97 %). The third genus *Microsporum* was totally absent.

Trichophytons were represented by four species *T. rubrum*, *T. mentagrophytes*, *T. tonsurans* and *T. verrucosum* and *Epidermophyton* by one species, viz. *E. floccosum*. *T. verrucosum* is a new record from India.

The isolates from Candidiasis all belonged to one species *C. albicans*.

Tinea versicolor and Erythrasma have respectively the genus *Melassezia* and *Microsporon* as their causative organisms.

T. rubrum is responsible for 50 % disease, *T. mentagrophytes* for 26 %, *T. verrucosum* and *T. tonsurans* for 8 % and 5 % respectively. Infection by *E. floccosum* is 3 % and *C. albicans* 8 %.

Acknowledgment

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STUDIES IN MEDICAL MYCOLOGY

II. CANDIDIASIS OF SCALP

by

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Introduction

Candidiasis is a fungus disease caused by *Candida albicans* which may produce lesions in mouth, skin, nail, vagina, lungs, bronchi and occasionally cause meningitis, endocarditis or septicema. The infection has been found to be of a localised as well as generalised nature in relation to the human body. Although it has been stated to infect all parts of the body (Moss & McQuown 1953), so far as the author is aware, in the available literature no instance or case of Candidiasis of human scalp has been reported. The present paper deals with a case of Candidiasis of scalp found by the author during the course of collection of dermatophytes from the Skin Department (outdoor) of King George's Medical College, Lucknow.

Symptoms

The infected scalp showed sharply demarcated raised lesions somewhat similar to the typical patches of thrush with a little whitish liquid oozing out from them. The patches were covered by a thick creamy white layer which on removal revealed a bright red moist base. The lesions were oval to rounded in shape rimmed with small pustules. These were many and of varied size, a few of them coalesced together to form larger ones. Lesions caused pain and loss of hair in the affected part. The clinical picture appeared similar to that of Dermatophytosis except that exudation was more free and the lesions in general more moist.

Material

The material was collected from the lesion on the scalp of a patient, diagnosed by the Dermatologist (Dr. R. N. Gupta) as a case of Candidiasis, by using usual technique.

The infected part was thoroughly swabbed with rectified spirit and scrapings were taken by means of a sterilized scalpel. These were stored in sterilized tubes for subsequent investigation. A portion of the scraping was directly examined under microscope to study the nature of fungal elements and another portion cultured on Sabouraud's glucose agar. Bacterial contamination was checked by adding penicillin (20 units per ml.) and Streptomycin (40 units

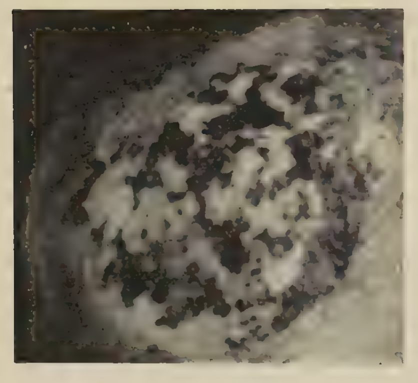

Fig. 1. Part of the infected scalp.

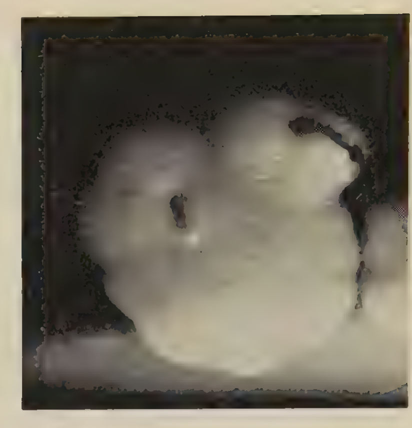

Fig. 2. Colony, 15 days, Sabouraud's glucose agar.

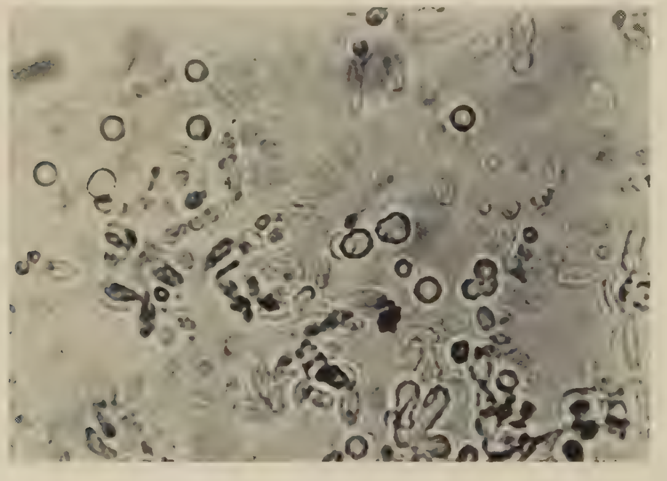

Fig. 3. Numerous large thick walled chlamydospores. Corn Meal Agar × 560.

per ml.) in the medium. The inoculated tubes were incubated at 37° C. from which pure monosporal cultures were obtained and stored as stock culture for further experiments.

Pathogen

A small amount of scraping of the diseased tissue was mounted on a slide in a drop in 10 % KOH solution with a cover-slip added and the preparation gently heated over the flame for clearing. This on examination revealed small, budding, oval, thin-walled yeast like cells with bits of hyphae also. The cells were approximately 3—4 μ in size. This along with the clinical diagnosis gave the indication as its being one of the species of Candida.

Culture

The pure monosporal cultures of the pathogen on Sabouraud's medium incubated at 37° C. appeared as slow growing, medium sized, flat, irregular, creamy and moist to dull colony. The colonies had a definite yeasty odour. Microscopic examination of the pathogen growing in culture stained with Lactophenol cotton blue showed thin walled, oval budding cells 3—4 μ in size, similar to those found in the diseased tissues.

Specific Identification

For specific identification the growth characters of the pathogen was studied in Glucose broth and Blood agar base. Heavy suspension of the pathogen in sterile saline solution served as inoculum. Chlamydospore production was studied in Corn Meal Agar for which inocula were planted deep down in the medium by cutting across its surface.

The further confirmation of the identity was sought in the fermentation reactions of the pathogen as suggested by MARTIN *et al* (1937). Glucose, Maltose, Sucrose and Lactose broths containing an indicator were inoculated and covered with a layer of paraffin 2 mm. over the surface, incubated at 37° C. and daily changes for pH and gas formation were studied. All the experiments were done in triplicates. The results are summarised in table I which shows that the strain obtained is identical with that of the species *albicans* which was further confirmed by comparison with the authentic species of *C. albicans* obtained from C.B.S. Baarn, Holland.

TABLE I.

	Growth Reaction	Fermentation Reaction	
Medium	Reaction of pathogen	Broth	Reaction
Blood Agar	Colonies medium sized to small, greyish dull in colour.	Glucose	A G
Sabouraud's broth	No surface growth, flocculant growth at the base.	Maltose	A G
Corn Meal	Branched tree like hyphae with thick walled round chlamydospores and ball like clusters of budding cells.	Sucrose	A
		Lactose	——

A G = Acid & Gas.
A = Acid.

Summary

Candidiasis of human scalp is reported for the first time from India. The characteristic symptoms of the disease are the sharply demarcated, raised oval to round lesions somewhat similar to typical patches of thrush with a little whitish exudation, causing pain

and loss of hair in the affected part. The pathogen is identified as *Candida albicans* and its growth and fermentation reactions have been studied in appropriate media.

Acknowledgments

The author is grateful to Prof. S. N. DAS-GUPTA for his guidance during the course of investigation. His thanks are due to Dr. R. N. GUPTA, Dermatologist, King George's Medical College, for clinical diagnosis of the patient.

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A METHOD FOR THE RAPID IDENTIFICATION OF THE GENUS CANDIDA

by
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(4.VIII.1958)

Since the introduction and the intensive use of certain antibiotics in clinical medicine, the incidence of Candidiasis has apparently increased. Therefore, it is important to differentiate and identify species of the genus *Candida* with regularity.

Candida species are usually identified by their morphological characteristics on special culture media and also by their ability to ferment certain sugars. However, it is not rare that *Candida* species are isolated which cannot be identified rapidly, and these methods become relatively time consuming for routine purpose compared with those used for the identification of various Salmonella strains.

Antigenic structures of the genera *Salmonella* and *Shigella* have already been established by Kauffmann, Boyd, and many other investigators (1, 2) and have also been used as an important basis for the classification of these organisms. That is, species or types of these bacilli are quickly differentiated by the slide agglutination methods, using mixed or unmixed monospecific antisera against their antigenic structures. This is performed after excluding other strains which do not belong to the genera on the basis of a few biological and cultural characteristics on the isolation and confirmatory media.

In previous reports (3—5), antigenic structures of several species of the genus *Candida* were postulated by the authors. Furthermore, it was stated that the antigenic structures of this genus could serve in classification since these properties are identical between many strains and the standard strains (6). Moreover, monospecific or absorbed antisera, homologous to thermostable or thermolabile antigens, could be prepared by means of absorption method based on the antigenic structures (3—6, 21—22).

In this study, slide agglutination test with monospecific or absorbed antisera were used, at first, to differentiate these organisms, and then the usual examination for species identification of the genus was carried out in order to confirm the former test. This was designed to observe whether the former identification method was accurate and practical, and also whether it could be performed

TABLE I

Antigenic structures of nineteen species of the genus Candida

Group	Species and donor	Thermostable antigens	Thermo-labile antigens
I	*C. albicans*, Harvard Univ. ← ATCC 10261	1, 2, 3, 4, 5, 6, 7	
	C. tropicalis, Harvard Univ.←ATCC 7349	1, 2, 3, 4, 5, 6	
II	*C. pseudotropicalis*, NI 7494←406th MGL←Duke Univ.←ATCC	1, 8, (10)	a
	C. macedoniensis, IFO 0706←ATCC 748	1, 8, 10,	(a)
	C. scottii, IFO 0736←SIFF←LM	1, 3, 4, 10	
	C. robusta, IFO 0718←IBL 2447	1, 2, 3, (10), (14), 18,	a, e
	C. stellatoidea, Harvard Univ.← ATCC 10264	1, 2, 3, 4, 5, (10)	
III	*C. krusei*, NI 7492←406th MGL←Duke Univ.-ATCC	1, 2, 5, (11),	b
	C. catenulata, IFO 0745←NRRL Y-1508	1, 2, 5, 11,	b
	C. reukaufii, IFO 0749←NRRL Y-1348	1, 2, (5), (11), (12),	b, f
	C. mycoderma, IFO 0734←SIFF V342a	1, 2, 5, 11, 12	
	C. rugosa, IFO 0591←RIMD	1, 2, 3, 4, 11, 19,	g
IV	*C. parakrusei*, Harvard Univ. ←ATCC 10232	1, 2, 3, 5, (13), (14), (15),	c
	C. parapsilosis, IFO 0708←ATCC 7330	1, 2, 3, 5, (13), (14), (15)	(c)
	C. pulcherrima, IFO 0561←NI 7477←Inst. of Hygiene, Montevideo←LM	1, 2, 3, 5, 13, 14, (15)	d
	C. zeylanoides, IFO 0719, ←IBL 2464←LM	1, 2, 3, 4, 13, 17,	(a), c, h
V	*C. guilliermondii*, OUT 582	1, 2, 3, 4, 9	
VI	*C. pelliculosa*, IFO 0707←ATCC 2149	1, 2, 14, 15, 16, 20	
	C. utilis, IFO 0619←LM L-840	(1), (2), (14), 16, 17,	c

ATCC	American Type Culture Collection, Washington, D. C.
NI	Nagao Institute, Tokyo
IFO	Institute for Fermentation, Osaka
SIFF	Institut National de la Santé Publique d'Oslo
LM	Laboratorium voor Microbiologie, Delft
IBL	Instituto Botanico, Faculdade de Ciencias de Lisbon
NRRL	Northern Utilization Research Branch, U.S. Dept. of Agriculture
RIMD	Research Institute for Microbial Diseases, Osaka University
OUT	Faculty of Technology, Osaka University
406th MGL	406th Medical General Laboratory, Tokyo
←	obtained from

Antigens, of which agglutinogenic capacities are very weak or may be absent are indicated in parenthesis.

routinely. This paper, thus, presents experimental results of three series of experiments where species identification by slide agglutination was performed without error.

Materials and Methods

Strains used: Standard strains employed in antigenic analyses to establish antigenic structures of various species (Table I) were also used in preparing monospecific or absorbed antisera. Most of these strains were obtained through the courtesy of Mr. HASEGAWA of the Institute for Fermentation in Osaka. Other strains were obtained from three different sources: 1. Strains isolated from materials obtained through the Otolaryngologic Clinic of the Kyoto National Hospital, 2. Strains isolated from oral cavities of patients suffering from dental diseases, and 3. Strains isolated from various sources in other laboratories which were sent to our laboratory for identification.

Monospecific or absorbed antisera, which were used to examine antigens of *Candida* strains, were prepared in the same manner as described in previous reports (3, 6, 7). Among the combinations, absorbed antisera homologous to some antigens, such as antigens 2 to 6 and 14 to 16, contain antibodies homologous to more than a single kind of antigen (Table II). Therefore, specific antigens should be proved by means of monospecific antisera, such as antiserum of antigen 7. Then, when antiserum of antigen 6 indicates positive reaction and antigen 7 is proved to be absent, it would indicate that antigen 6 is present. Similarly, an existence of single antigen, such as 4 or 5, can be determined by the absence of both antigens 6 and 7. There were no discrepancies between the results of the experiments, one using monospecific and the other absorbed antiserum, i.e., *C. tropicalis* antiserum absorbed with *C. stellatoidea* and *C. albicans* antiserum absorbed with *C. stellatoidea*. It may be added here that absorbed but non-monospecific antisera are useful as a supplementary means. Although monospecific antisera homologous to every antigen may be prepared in several ways, between species for immunization and absorption, the combinations of species most recently used are also shown in Table II. These combinations were used in preparing monospecific or absorbed antisera because relatively high titers of the antisera could be maintained after absorption. The effectiveness of monospecific antisera, however, was relatively unstable even under refrigeration.

The presence of antigens in every strain was examined by the slide agglutination test using monospecific or absorbed antisera. Unheated organisms were used as antigens even when thermostable antigens were examined; however, heated organisms were sometimes used when expected positive reactions did not show distinct results.

Species identification performed by the slide agglutination method was later compared with the identification of the modified

TABLE II

Combinations of species for the preparation of monospecific or absorbed antisera

Absorbed antiserum homologous to thermostable antigen	Antiserum from animal immunized with heated organisms	Heated organisms for absorption
1	C. alb.	
2	C. alb.	C. pt.
3	C. pk. or C. alb. *)	C. kr.
4	C. st. or C. alb. *)	C. pk.
5	C. st. or C. alb. *)	C. glm.
6	C. tr. or C. alb. *)	C. st.
7	C. alb.	C. tr.
8	C. pt. or C. mac.	C. alb. + C. sct.
9	C. glm.	C. alb.
10	C. sct.	C. alb.
11	C. kr. or C. cat.	C. alb.
12	C. myc.	C. kr.
13	C. pul.	C. alb. + C. pel.
14	C. pul.	C. alb.
15	C. pel.	C. ut.
16	C. pel.	C. pk.
17	C. ut.	C. pel.
18	C. rob.	C. alb. + C. pk. + C. pt.
19	C. rug.	C. alb. + C. kr.
20	C. pel.	C. alb.+C. ut.+C. rob.+C. pk.
21	H. sat.	C. pel.
22	H. cal.	H. sat.

Absorbed antiserum homologous to thermolabile antigen	Antiserum from animal immunized with unheated organisms	Heated organisms for absorption	Unheated organisms for absorption
a	C. pt. or S. fr. *)	C. pt. or S. fr. *)	
b	C. kr.	C. kr.	
c	C. ut.	C. ut.	
d	C. pul.	C. pul.	
e	C. rob.	C. rob.	+ C. pt.
f	C. rk.	C. rk.	+ C. kr.
g	C. rug.	C. rug.	
h	C. zey.	C. zey.	+ C. pk. + C. pt.

C. alb.	*C. albicans*	C. cat.	*C. catenulata*	C. glm.	*C. guilliermondii*
C. kr.	*C. krusei*	C. mac.	*C. macedoniensis*	C. myc.	*C. mycoderma*
C. pk.	*C. parakrusei*	C. pel.	*C. pelliculosa*	C. pt.	*C. pseudotropicalis*
C. pul.	*C. pulcherrima*	C. rk.	*C. reukaufii*	C. rob.	*C. robusta*
C. rug.	*C. rugosa*	C. sct.	*C. scotii*	C. st.	*C. stellatoidea*
C. tr.	*C. tropicalis*	C. ut.	*C. utilis*	C. zey.	*C. zeylanoides*
H. cal.	*Hansenula californica*	H. sat.	*H. saturnus*	S. fr.	*Saccharomyces fragilis*

+ and then absorbed with

*) The combination has been used since the middle of 1957.

techniques of MARTIN et al. (8), LODDER & KREGER-VAN RIJ (9): growth on Sabouraud's broth and agar, and corn meal agar, and reactions on sugar fermentation and sugar assimilation. This was done in order to ascertain the accurateness of the former identification method. Moreover, biological examinations were carried out independently by the authors as well as others who performed the slide agglutination test.

Results

1) Strains from Otolaryngological Sources.

This experiment was carried out through the courtesy of Dr. K. YAMASHITA, Director of the Otolaryngological Clinic of the Kyoto National Hospital. On May 7, 1956 Dr. Y. FUKAZAWA, one of our collaborators, went to the hospital to perform the serology. He took with him 19 kinds of the monospecific antisera homologous to thermostable antigens 3 to 13 and 15 to 18, as well as thermolabile antigens a to d. He was given 104 strains of fungi, grown on Sabouraud's agar slants, for his serological identification. The usual biological method identified these strains, but the results were not available to him until the conclusion of the slide agglutination test.

The presence of antigens in 92 strains was examined by using monospecific antisera, since 12 strains showed spontaneous agglutination reactions against the sera. On the afternoon of May 10, 1956 both methods of species identification were presented and compared. YAMASHITA (10) reported that "the serological method could give the consistency with the mycological identification in about 83 %." However, the coincidence of both identifications was assumed on a premise that biological identifications should always be correct. Since the results in the two methods did not coincide in some cases, they were further examined.

Of the 92 strains tested, 3 were found to be nonviable upon receipt and 4 had no identification reports. Therefore, only 85 strains were available for use in comparing experimental results. The final identity of these 85 strains was decided from the results obtained through both biological and serological reactions in our laboratory and also in reference to the biological characteristics shown in Kyoto.

The correlation of biological to the final identification was 80.0 % (Table III). Of the 50 strains of *C. albicans* listed in the final identification, for example, 46 strains were identical to those obtained by biological tests. The identity of the remaining 4 strains, however, did not agree biologically in spite of careful examinations. Among other strains, some showed discrepancies between both biological and final identifications. On the other hand, the correlation of serological to the final identification was 94.1 % (Table IV). Of the 50 strains of *C. albicans*, 48 agreed serologically with the final identification. Consequently, it can be concluded that serological identification method is not inferior to biological method of LODDER & KREGER-VAN RIJ.

TABLE III

Comparison of Identifications by Biological Method and by Combined Method of Biological and Serological Examinations.

Biological Identification / Final identification	*C. albicans*	*C. tropicalis*	*C. krusei*	*C. parakrusei*	*C. guilliermondii*	*C. stellatoidea*	*C. solani*	*C. scottii*	*C. utilis*	*C. pseudotropicalis*	*C. reukaufii*	*Rhodotorula* sp.	*Torulopsis* sp.	*Saccharomyces* sp.	Total
C. albicans . . .	46			1	1		1			1					50
C. tropicalis . . .	1	4													5
C. krusei			2												2
C. parakrusei . .	1			6					1						8
C. guilliermondii .						1		1		1					3
Candida sp. . . .				1			1								2
Rhodotorula sp. .												1			1
Torulopsis sp. . .	1							2					4		7
Saccharomyces sp.														5	5
Hansenula anomala	1														1
Ustilago sp. . . .											1				1

TABLE IV

Comparison of Identifications by Slide Agglutination Method and by Combined Method of Biological and Serological Examinations

Serological Identification / Final Identification	*C. albicans*	*C. tropicalis*	*C. alb.* or *C. trop.*	*C. krusei*	*C. parakrusei*	*C. guilliermondii*	*C. stellatoidea*	*Other yeasts* 1)	Total
C. albicans	48	1			1				50
C. tropicalis		4	1						5
C. krusei				2					2
C. parakrusei . . .					8				8
C. guiliermondii . .						1	1	1	3
C. sp.	1							1	2
Rhodotorula sp. . .								1	1
Torulopsis sp. . . .								7	7
Saccharomyces sp. .								5	5
Hansenula anomala.								1	1
Ustilago sp.								1	1

1) *Candida* sp., of which antigenic structures are unknown, and other yeast sp.

2) Oral strains of the genus *Candida.*

Two hundred and four strains were isolated from salivas of 666 patients suffering from dental diseases. Twenty-five strains showed spontaneous slide agglutination reactions against the absorbed antisera; thus, they were excluded from the experiment. The other 179 strains were identified previously by Lodder & Kreger-van Rij's modified system (Table VIII). On the other hand, species identification of strains were carried out independently by means of slide agglutination, using monospecific or absorbed antisera as described above (Table VII, IX). When biological reactions did not correspond to the serological identification of the strains, biological examinations, such as chlamydospore formation and sugar fermentation, were repeated until the findings of the strain corresponded to the characteristics of the species determined serologi-

Table v.

Production of Chlamydospores by Candida albicans by Slide Culture Method

No. of times studied	1	2	3	4—7
No. of strains producing chlamydospores	41	63	17	16
Total No. of strains, including the preceeding experiments	41	104	121	137
%	30.1	76.4	88.9	100.0

No chlamydospore was found in 9 strains of *C. albicans.*

Table vi

Times of Sugar Fermentation Reactions Until Final Identifications of Test Strains Were Determined Biologically and Serologically

No. of times . . .	1	2	3	4	5	6—8
No. of strains . . .	26	39	21	12	31	38
Total No. of strains, including the preceeding experiments.	26	65	86	98	129	167
%	15.7	39.3	52.0	59.2	78.0	100.0

Experimental results of 12 strains are not included in the Table, since their final species identification could not be determined.

cally. Thus, the final identification of every strain was established by biological and serological reactions (Table IX). Although the slide agglutination test was performed only once against a single strain, and, in a few instances only twice, with reference to biological reactions, corn meal slide cultures for chlamydospore formation

TABLE VII

Comparison of Species Identifications by Slide Agglutination Method and by Combined Method of Biological and Serological Examinations

Final Identifications \ The First Serological Identifications	*C. albicans*	*C. tropicalis*	*C. krusei*	*C. parakrusei*	*C. guilliermondii*	*C. mycoderma*	*Candida* sp.	Total
C. albicans	141			1			4	146
C. tropicalis		5						5
C. krusei			4					4
C. parakrusei . . .				2				2
C. guilliermondii . .					6		3	9
C. mycoderma . . .						1		1
Candida sp.	2						10	12

TAGLE VIII

Comparison of Identifications by Single Biological Test and by Combined Method of Biological and Serological Examinations.

Final identification \ The first biological identification	*C. albicans*	*C. tropicalis*	*C. krusei*	*C. parakrusei*	*C. guilliermondii*	*C. mycoderma*	*C. claussenii*	*C. tenuis*	*C. solani*	*C. scottii*	*C. melibiosi*	*C. humicola*	*C. stellatoidea*	*C. reukaufii*	*Candida* sp.	Total
C. albicans	95	2	2	5			1	2	3	2	3	1	1	1	28	146
C. tropicalis		4													1	5
C. krusei			3	1												4
C. parakrusei . . .				2												2
C. guilliermondii . .	1		1	2							1				4	9
C. mycoderma . . .															1	1
Candida sp.	2	1													9	12

TABLE IX

Serological Identification of All Strains Based on Antigens present and Final Identifications of the Same Strains on the Basis of Biological and Serological Characteristics

Pseudomycelium	Chlamydospore	Serological examinations			Biochemical examinations								No. of strains	Final identification with reference to both examinations
					Fermentation				Assimilation					
		Containing antigens by slide agglutination method	No. of strains	The first serological identification	Glucose	Sucrose	Maltose	Lactose	Glucose	Sucrose	Maltose	Lactose		
+	+	2, 3, 4, 5, 6, 7	146¹)	C. alb.	AG	A or-	AG	—	+	+	+	—	118	C. alb.
+	+				AG	AG	AG	—	+	+	+	—	18	
+	+				AG	A	A	—	+	+	+	—	1	
+	—				AG	A or-	AG	—	+	+	+	—	9	
+	—	2, 3, 4, 5, 6	5	C. tr.	AG	AG	AG	—	+	+	+	—	5	C. tr.
+	—	2, 5, 11, b	4	C. kr.	AG	—	—	—	+	—	—	—	4	C. kr.
+	—	2, 3, 5, 13, 14, 15, c	2	C. pk.	AG	—	—	—	+	+	+	—	2	C. pk.
+	—	2, 3, 4, 9	6	C. glm.	AG	AG	A	—	+	+	+	—	6	C. glm.
+	—	2, 5, 11, 12	1	C.myc.	A	A	A	—	+	—	—	—	1	C. myc.
+	—	2, 3, 4	3	C. sp.	AG	AG	A	—	+	+	+	—	3	C. glm.
+	—	3, 4, 5, 6, 13, 14, 15	1	C. sp.	A	A	A	—	+	+	+	—	1	C. sp.
+	—	5±, 11	1	C. sp.	A	A	—	—	+	—	—	—	1	C. sp.
+	—	2, 3, 4, 5, 6, 10	1	C. sp.	AG	AG	A	—	+	+	+	—	1	C. sp.
+	—	2, 3, 4, 5, 6, 10, 14, 15, 16	1	C. sp.	AG	AG	AG	—	+	+	+	—	1	C. sp.
+	—	2, 3, 4, 5, 6	2	C. alb.	AG	—	—	—	+	+	+	—	1	C. sp.
					AG	AG	—	—	+	+	—	—	1	C. sp.
+	—	3±, 11	1	C. sp.	AG	—	—	—	+	+	+	—	1	C. sp.
+	—	3, 4, 5, 11, 13, 14	1	C. sp.	AG	A	AG	—	+	+	+	—	1	C. sp.
+	—	3, 5, 13, 14	1	C. sp.	AG	AG	AG	—	+	+	+	—	1	C. sp.
+	—	None	1	C. sp.	A	—	—	—	+	+	+	—	1	C. sp.
+	—		1	C. sp.	A	A	—	—	+	+	+	—	2	C. sp.
+	—	3, 4, 5, 6, 13, 14	1	C. sp.										

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¹) Reexaminations of 5 strains were carried out serologically with heated organisms of each strain. Because 4 strains of them had been identified, at first, as *Candida* sp. and one strain as *C. parakrusei* serologically with unheated organisms of each strain as in Table VII.

± doubtful reaction.

were repeated seven times (Table V). Sugar fermentation tests were repeated eight times (Table VI). The correlation of the first serological to the final identification was 94.4 %; however, the correlation of the first biological to the final identification was 63.1 %. Since biological examinations would always be carried out repeatedly, whenever they should be performed, the correlation of the biological to the final identification would not be of low per cent. However, the agglutination test was more accurate and faster than the simple biological methods generally used in medicine.

Formation of chlamydospore by *C. albicans* is one of the most important and specific characteristics of this species. However, DIDDENS & LODDER (11), LODDER & KREGER-VAN RIJ (9), NICKERSON & MANKOWSKI (12), DONOMAE (13) and TSUCHIYA et al. (14) reported many strains without this characteristic of chlamydospore formation. In this experiment, 9 strains out of 146 strains of *C. albicans* did not produce chlamydospores in spite of repeated slide cultures (Table V). The identification of *C. albicans*, which lacks chlamydospore formation, is very difficult when its presence is relied upon during an examination. Positive slide agglutination reactions of such a *C. albicans* strain will lead to its identification without hesitation.

3) Strains Sent from Various Laboratories for Identification.

When strains are sent to our laboratory for identification, every strain is, at first, examined by the slide agglutination test with the monospecific or absorbed antisera. If a strain belongs to a species whose antigenic structure has been established, its identification can be accomplished immediately. However, if a strain is a variant, and if the antigenic analyses of the species to which the strain belongs has not yet been carried out, it cannot be distinguished by the slide agglutination method alone.

Many investigators reported that most isolates from human sources of the genus *Candida* were strains of *C. albicans*, and occasionally, *C. tropicalis*, *C. krusei* and *C. parakrusei*. Other *Candida* species are seldom found in human materials. This is similar to the author's case. Table X shows 20 strains of many isolates which were sent to our laboratory for identification from time to time. Three strains of the genus *Hansenula* obtained from human origins were identified in our laboratory. One of these was isolated from an otological patient, the other from a patient suffering from lung tuberculosis, and the last from a patient of acute panperitonitis due to a perforation of the appendix. Biological characteristics of two of the three strains were similar to *C .tropicalis* in fermentation and assimilation reactions, but not in the reaction using potassium nitrate. This compound is not used in the method of MARTIN et al. However, the antigenic structures of the two strains were absolutely different from that of *C. tropicalis*, and they showed the same antigenic structure as that of *Hansenula anomala*. The third strain was identified, first, serologically as *H. mrakii* or *H. saturnus*, and later, the biological identification established this to be *H. mrakii.* In December 1957, a Sezaki strain was brought to our laboratory for identification and it was identified within ten minutes as *C. krusei* by the slide agglutination test using monospecific antisera. This may indicate the value and reliability of our slide agglutination test using monospecific antisera.

TABLE X

Serological and Biological Characteristics of Strains received for Identification

Date of examination	Names of strains	Containing antigens examined by slide agglutination method	Biological examinations										Final identification
			Pseudomycelium	Chlamydospore	Fermentation				Assimilation				
					Glucose	Sucrose	Maltose	Lactose	Glucose	Sucrose	Maltose	Lactose	
Oct., 1955	Yamamoto	3, 5, c	+	—	AG	A	—	—	+	+	—	—	C. pk.
Oct., 1955	Inoue	3, 4, 5, 6, 7	+	—	AG	A	AG	—	+	+	+	—	C. alb.
Oct., 1955	Mawatari	3, 4, 5, 6, 7	+	—	AG	A	AG	—	+	+	+	—	C. alb.
Nov., 1955	F-104	3, 4, 5, 6, 7	+	+	AG	A	AG	—	+	+	+	—	C. alb.
Nov., 1955	F-103	3, 4, 5, 6, 7	+	+	AG	A	AG	—	+	+	+	—	C. alb.
June, 1956	Takatsuka	2, 3, 4, 5, 6, 7	+	+	AG	AG	AG	—	+	+	+	—	C. alb.
June, 1957	Ito	3, 4, 5, 6	+	+	AG	AG	AG	—	+	+	+	—	C. alb.
June, 1957	Takizawa	3, 4, 5, 6	+	+	AG	AG	AG	—	+	+	+	—	C. alb.
May, 1957	Ozaki	2, 3, 4, 5, 6	+	—	AG	AG	AG	—	+	+	+	—	C. alb.
July, 1957	Saka-7	2, 14, 15, 16, 20	+	—	AG	AG	AG	—	+	+	+	—	H. an.
June, 1957	Tsuruoka	2, 14, 15, 16, 20	+	—	AG	AG	AG	—	+	+	+	—	H. an.
Sept. 1957	Jieitai	2, 3, 4, 5, 6, 7	+	+	AG	AG	AG	—	+	+	+	—	C. alb.
Dec., 1957	Sezaki	2, 5, 11, b	+	—	AG	—	—	—	+	—	—	—	C. kr.
Dec., 1957	C-2-3	2, 3, 4, 5, 6	+	—	AG	AG	AG	—	+	+	+	—	C. tr.
Dec., 1957	MH-49	2, 3, 4, 5, 6	+	—	AG	AG	AG	—	+	+	+	—	C. tr.
Dec., 1957	Komeji	2, 3, 4, 5, 6, 7	+	+	AG	—	AG	—	+	+	+	—	C. alb.
Dec., 1957	Amano	2, 3, 4, 5, 6	+	—	AG	AG	AG	—	+	+	+	—	C. tr.
Dec., 1957	Iwashita	2, 5, 11, b	+	—	AG	—	—	—	+	—	—	—	C. kr.
Dec., 1957	Ogiwara	2, 14, 15, 16, 17±, 20, 21	—	—	AG	—	—	—	+	—	—	—	H. mr.
Jan., 1958	Fukano	2, 3, 4, 5, 6, 7	+	+	AG	A	AG	—	+	+	+	—	C. alb.

H. mr. *Hansenula mrakii*

Discussion

The appreciable increase in infection caused by *C. albicans* following the extensive use of broad spectrum antibiotics has renewed the interest in *Candida* infections and their identification. Species belonging to the genus *Candida* are pseudomycelium forming, non-pigment producing, anascosporogenous yeasts. The identification of various species is usually based on morphological characteristics and biochemical activities (15, 8, 9, 11). Strains of the same species may exhibit variations in biological properties, and *C. albicans* may fail to develop chlamydospores. For these reasons complete identifications of the strains may take over a month. Therefore, several workers reported various rapid diagnostic tests designed to differentiate the species of the genus (16—20). Since many strains of the genus *Candida* vary greatly in their ability to ferment sugars or to produce chlamydospores, it would appear that there is a relatively small significance in improving biological examinations. On the other hand, serological tests, until recently, were of little diagnostic significance due to cross reactions among species. The authors carried out antigenic analyses of seven species of the genus *Candida* and found specific antigenic structures in them (3). Also, monospecific antisera could be prepared by the absorption method, and this study was extended to nineteen species of the genus (4, 5). With monospecific or absorbed antisera, species identification of the *Candida* genus was carried out in a similar manner to that used for the genus *Salmonella*.

For the preparation of monospecific antisera, known strains of the species must be used for immunization and absorption as in the case of the genus *Salmonella* (Table I). Moreover, combinations of species used for immunization and absorption, shown in Table II, are effective in preparing monospecific or absorbed antisera employed for the examination of antigens present in every strain tested. The monospecific antisera homologous to thermostable antigen 7 is prepared by absorbing the antiserum obtained from animal immunized with heated cells of the standard strain of *C. albicans*, with heated cells of the standard strain of *C. tropicalis*. When D strains of *C. albicans* and *C. tropicalis* were used in place of the standard strains for the preparation of the monospecific antiserum homologous to antigen 7 (Table XI), the *C. albicans* (D strain) antiserum absorbed with *C. tropicalis* (D) showed positive agglutination reactions against D and H strains of *C. albicans*, thirteen isolated strains of *C. albicans*, as well as H strain, and four isolated strains of *C. tropicalis*, except *C. tropicalis* (D). Moreover, the *C. tropicalis* (D) antiserum absorbed with *C. albicans* (D) indicated positive reaction against only *C. tropicalis* (D). Thus, the D strain of *C. tropicalis* was shown to have a unique antigen independent of four of the *C. tropicalis* isolates. *Candida albicans* (D) and *C. tropicalis* (D) are authentic strains; both are morphologically and biologically similar to the standard strains. Therefore, it might be emphasized that definite strains must be used for the preparation of monospecific antisera. For some obscure reason, the preparation of monospecific antiserum homologous to antigen 7 was difficult during some stages. Monospecific antiserum homologous to antigen 9 was also difficult to prepare.

TABLE XI

Antigenic analyses of C. albicans and C. tropicalis

Antiserum from animal immunized with heated cells	Heated cells for absorption	Heated antigens used for slide agglutination										
		C. alb. (D)	C. alb. (H)	13 isolates of C. alb.	C. tr. (D)	C. tr. (H)	4 isolates of C. tr.	C. pt.	C. kr.	C. pk.	C. glm.	C. st.
C. alb. (D)	C. tr. (D)	+	+	+	—	+	+	—	—	—	—	—
C. tr. (D)	C. alb. (D)	—	—	—	+	—	—	—	—	—	—	—
C. alb. (H)	C. tr. (H)	+	+	+	—	—	—	—	—	—	—	—
C. tr. (H)	C. alb. (H)	—	—	—	—	—	—	—	—	—	—	—

Both strains of *C. albicans* (H) and *C. tropicalis* (H) are the same strain shown in Table I. The other two strains, *C. albicans* (D) and *C. tropicalis* (D), were obtained from the Duke University through the 406 th MGL.

The preparation of antigens, the immunization method of animals and the technique of the preparation of absorbed antisera, as well as slide agglutination method described in the previous report (7), are the best methods at the present time. The titers of monospecific antisera dropped relatively quickly with time even under refrigeration. Our attempt at preserving the titer by lyophilization had failed.

The slide agglutination test with monospecific antisera is a rapid and reliable method for species identification of the genus *Candida* as described above. In the previous report (14) the authors selected at random nine from forty-five strains of *C. albicans* identified with monospecific antisera, which did not produce any chlamydospores. After inoculating these nine nonchlamydospore forming strains intravenously into rabbits, four were recovered which showed chlamydospore formation.

It would be convenient to use the monospecific antisera homologous to group specific antigens, such as antigens 6, 10, 11, 13, 9 and 16 for screening in the first differentiation. However, difficulties were encountered in preparing and preserving many kinds of monospecific antisera. Moreover, the authors frequently encountered species which could not be determined by serological and biological examinations as shown in Table IX. On the other hand, *Candida* species, which many investigators have isolated from various human sources, belonged mainly to but a few species, such as *C. albicans, C. tropicalis, C. krusei* and *C. parakrusei.* Consequently, a number of necessary monospecific antisera might be restricted practically to about ten. From the standpoint of monospecific antisera, those which are homologous to antigens 6, 11 and 13 are most important for identification. Factor sera of antigens 3, 4 and 5 and monospecific antisera homologous to antigens 9, 8, 10 and 7 are also necessary. The other factor sera homologous to thermolabile antigens are not necessarily important. However, monospecific antisera of antigens 18 and 20 are required for the differentiation of strains of the genera *Hansenula* and *Saccharomyces* from the genus *Candida.* These are necessary because some of the former strains are biologically identical to species of the genus *Candida,* should the method of Martin et al. be followed.

Although the antigenic structures of nineteen species of the genus *Candida* have been established, it would be necessary to revise them for practical use. Every antigen of the antigenic structures was assumed to be identical in similar amounts on the basis of positive agglutination reactions, even if differences in reactions, such as slightly or strongly positive, were observed. However, when an absorbed antiserum showed a slightly positive reaction, a certain antigen, homologous to the antibodies, might sometimes be lacking in a strain of a species. This antigen, also, may not have the ability to stimulate antibody formations. Consequently, it should be emphasized again that the combinations of species should be elaborated for the preparation of effective monospecific antisera.

Finally, although a species identification test with monospecific or absorbed antisera is a reliable method, the authors do not intend to insist that only serological examination be used. In the identification of the genus *Candida,* however, the authors cannot rely entirely upon the biological reactions, nor upon serology alone. Both methods must be employed together for accurate identification as in the genus *Salmonella.* Also, for rapid identification of *Candida* species, serological methods would be more practical routinely than biological reactions. Moreover, a serological test is superior in accurateness and rapidity to the usual biological method, if these test were to be performed only once.

Summary

Serological identification tests were carried out with many strains obtained from an otolaryngologic clinic, from oral cavities of dental patients and from other laboratories. The tests were performed through the slide agglutination method using monospecific or absorbed antisera based on the antigenic structures. The results of serological tests were compared with biological identifications.

Since serological identifications alone were found to coincide well with the correlative identifications by biological and serological methods, it is concluded that the identification test using monospecific antisera, based on the antigenic structures of the genus *Candida*, is a useful and reliable method for a rapid identification of species.

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A YEAST IN THE STOMACH OF THE MOUSE

by

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VAN UDEN (1952) isolated a new species of yeast, *Torulopsis pintolopesi*, from the peritoneum of mice inoculated with the fungus *Acladium castellani* and ARTAGAVEYTIA-ALLENDE (1953) stated that the same species was isolated by him from the peritoneum of mice inoculated with soil suspensions and even from one mouse inoculated with a sterilized sample. PARLE (1957) cultivated *T. pintolopesi* from the intestinal contents of eleven out of fifteen mice and he thought that the yeast is a common host in the alimentary tract of the mouse and some other rodents. According to the first two papers quoted the yeast is able to invade the tissues. The mouse is a very useful laboratory animal for the experimental study of several mycoses and the actual habitat of *T. pintolopesi* was deemed worthy of more investigation.

Smears were prepared with the epithelium of the washed stomachs and the intestine of twenty-nine adults white mice and five gray mice. The smears were stained with Gram technique. We observed budding yeasts, sometimes very abundant, in the stomach of all the thirty-four male and female mice. Yeasts were not found in the smears prepared with the intestinal epithelium.

Cultures were done from eight stomachs on Sabouraud glucose agar with penicillin and streptomycin, pH 5.6. After three to six days in the incubator at 30° C numerous small colonies of a slow growing yeast were seen. Three strains were completely studied. The study of the assimilation of sugars was made in a liquid medium as recommended by LODDER & KREGER-VAN RIJ (1952) and we obtained doubtful results but after the addition of 0.5 % bactopeptone the results were clear.

Histological sections of the stomach stained with Gram technique showed yeasts on the surface of the epithelium of the glandular part and also in the lumen of the tubular glands. In sections stained with hematoxylin-eosin it was difficult to see the yeasts. No inflammatory reactions were observed. The tissue sections of the small and large intestines did not reveal the presence of yeasts but some could be seen in the intestinal contents. No yeasts were found in the esophagus.

The yeast was cultivated on Sabouraud glucose agar at pH values from 2 to 9. No growth was observed at pH 9 and PH 8. Scarce growth at pH 7.6 and pH 7.2. Good growth was recorded along the acid side of the scale, even at pH 2.

Cultures from the omentum, spleen and lungs were negative but we obtained positive results from the abdominal lymph nodes of four out of twenty-nine mice. Two of these cultures were completely studied and they were identical to those isolated from the stomach.

We inoculated intravenously five mice with a young culture. Seven days later the mice were killed. No lesions were found and the cultures from the spleen and lungs were negative.

Summary.

The high incidence (100 %) of *Torulopsis pintolopesi* in the stomach of the mouse and the absence of any type of inflammatory response show the existance of an adaptation between the yeast and the mouse. This is in agreement with the opinion of PARLE that the yeast belongs to the normal flora of the digestive tract. According to our studies *T. pintolopesi* is an acidophilic species which is a normal host in the stomach and a transient organism in the intestine.

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CONSIDERAZIONI INTORNO AD „ENDOMYCOPSIS FIBULIGER (LINDNER) DEKKER"

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Nel corso di alcune richerche sopra i lieviti presenti nelle uve e nei mosti della regione viticola di S. Paolo in Brasile si è avuta occasione di isolare numerosi ceppi di *Endomycopsis*.

Il reperto ci è apparso ecologicamente interessante poichè non risulta che specie di *Endomycopsis* siano state rinvenute su uva. Catalogammo i ceppi, I, 47, 59, 82, 83, 123, 127, rispettivamente isolati da:

ceppo I: isolato da uva raccolta in pianta (vitigno IAC/538-2.[1])
,, 47: isolato da mosto d'uva del vitigno IAC/116-9 prima dell'inizio della fermentazione.
,, 59: id. da mosto ottenuto con uva del vitigno IAC/116-29
,, 82: isolato durante il corso della fermentazione da mosto ottenuto con uve del vitigno IAC/116-9
,, 83: id. da mosto ottenuto con uve del vitigno IAC/116-29
,, 123: isolato da mosto d'uva del vitigno IAC/164-20 prima dell'inizio della fermentazione
,, 127: id. da mosto ottenuto con uve del vitigno IAC/527-64

Agevole ne fu la determinazione generica; meno agevole la determinazione specifica. Perchè, se chiaro si presentò il quadro morfologico, molto meno chiaro risultò il quadro fisiologico.

In effetti gli elencati ceppi apparirono tutti morfologicamente non dissimili da *E. fibuliger* (Lindner) Dekker. Se mai occorse a noi di incontrare aschi non solo inseriti alle estremità o lungo le ife, ma qualche volta e tipicamente prendenti origine da grosse cellule globose o piriformi, in genere molto vacuolizzate, isolate od anche in serie. Inoltre, insieme a spore a forma di cappello, incontrammo talvolta spore tondeggianti, in questo caso provviste di goccia oleosa od anche spore saturni formi.

Con tutto ciò il generale aspetto morfologico non ci sembrò dissimile, come accennato, da quello noto per *E. fibuliger*.

Più complesso apparì il quadro fisiologico, specie per quanto ha riferimento alle fermentazioni.

Ma quì giova riportare qualche notizia intorno a quanto è noto circa la fisionomia zimologica sia della specie tipo che di specie altrimenti descritte.

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[1] 1AC, significa ibrido prodotto nell' Istituto Agronomico di Campinas.

Lindner affermò che *E. fibuliger* fermenta:

glucosio +
saccarosio +
maltosio —
lattosio + (debole)
raffinosio + (debole)

Intanto Saito descrisse non molto tempo dopo *E. lindneri* ed *E. hordei.*

E. lindneri differirebbe da *E. fibuliger* per la mancata fermentazione del maltosio; *E. hordei,* invece, per caratteri di ordine sporologico.

Stelling-Dekker studiando queste specie nei ceppi originali trovò non concordante lo zimogramma di *E. fibuliger* dato da Lindner e lo zimogramma di *E. lindneri* dato da Saito portando, l'una e l'altra specie, al seguente risultato:

glucosio + (debole)
galattosio —
saccarosio + (debole)
maltosio + (debole)
lattosio —

Pertanto *E. lindneri* e *E. hordei* furono fuse con *E. fibuliger* tenendole appena distinte come varietà.

Lodder & Kreger-van Rij, nel confermare i risultati di Stelling-Dekker, ritengono addirittura le specie di Saito come sinonimi di *E. fibuliger.* In più, questi Aa., trovarono che *E. fibuliger* assimila: glucosio, saccarosio, maltosio.

In definitiva *E. fibuliger* è specie debolmente fermentante glucosio, saccarosio, maltosio; il raffinosio è fermentato per $\frac{1}{3}$ o più. Glucosio, saccarosio e maltosio sono anche bene assimilati.

Finalmente Socias e coll. nel 1954 (Microbiologia Espanola, **7**, 107, 1954) hanno descritto *E. balearica* come nuova specie. I caratteri di questa specie sono, fondamentalmente, identici a quelli di *E. fibuliger*; unica differenza la fermentazione energica del glucosio.

A tal punto è il caso di esaminare quanto noi abbiamo rilevato nei ceppi isolati circa la assimilazione come la fermentazione degli zuccheri.

Per quanto riguarda l'assimilazione dei carboidrati nessuna differenza, invero, abbiamo trovato rispetto ai reperti di Lodder & Kreger van Rij [1]). Se mai abbiamo notata una più scarsa utilizzazione del maltosio rispetto al glucosio e al saccarosio.

I reperti zimologici, invece, come si vede nella tabellina annessa, sono apparsi in alcuni ceppi un poco diversi.

Giova dire che i risultati segnati in Tabella sono rimasti sempre costanti durante le varie prove di conferma.

---

[1]) Estese le prove di assimilazione ad altri composti tutti i ceppi isolati hanno dimostrato di non assimilare glicerina, mannite, sorbite, acetati, tartrati, citrati, succinati. Tutti si sono invece sviluppati, se pure non molto, in mezzi contenenti etanolo come sorgente di carbonio.

Delle sostanze azotate hanno dimostrato assimilare bene peptone; meno bene solfato ammonico; di non assimilare nè nitrati, nè asparagina, nè urea.

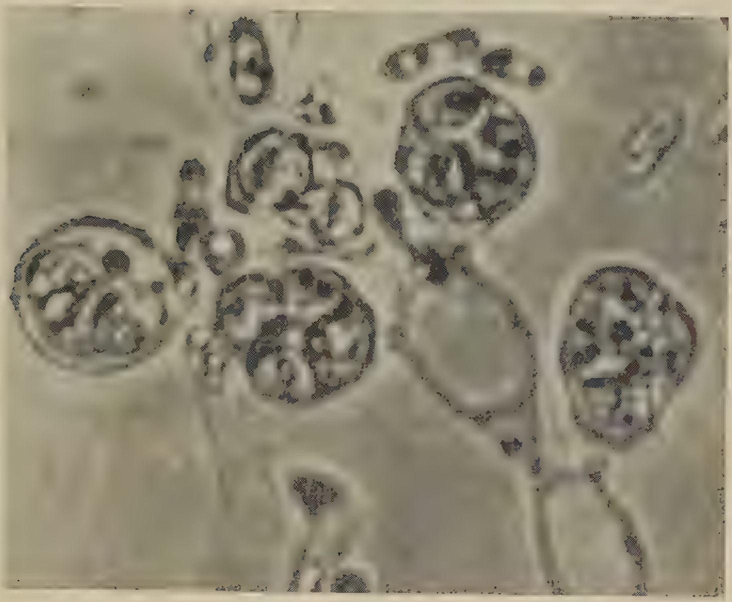

Fig. 1 — Formazione di aschi nel ceppo no. 59

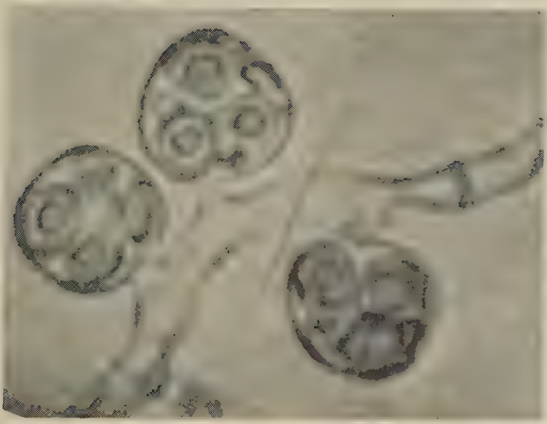

Fig. 2 — Aschi inseriti lungo le ife nel ceppo no. 83

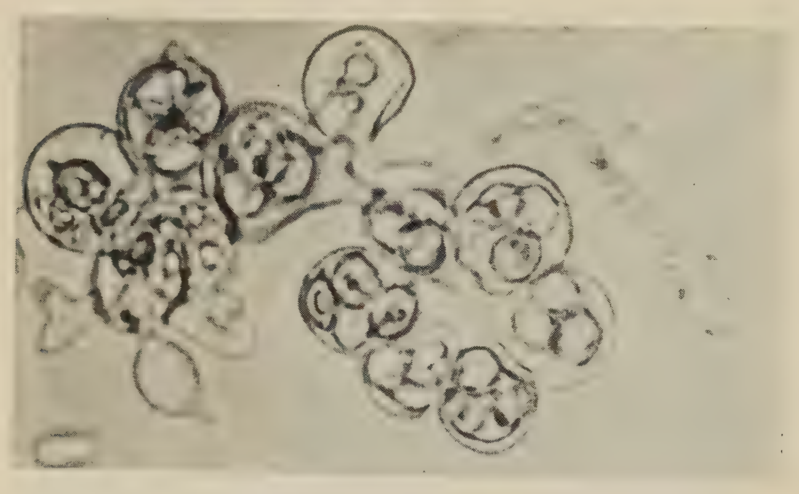

Fig. 3 — Aschi riuniti a grappolo nel ceppo no. 47

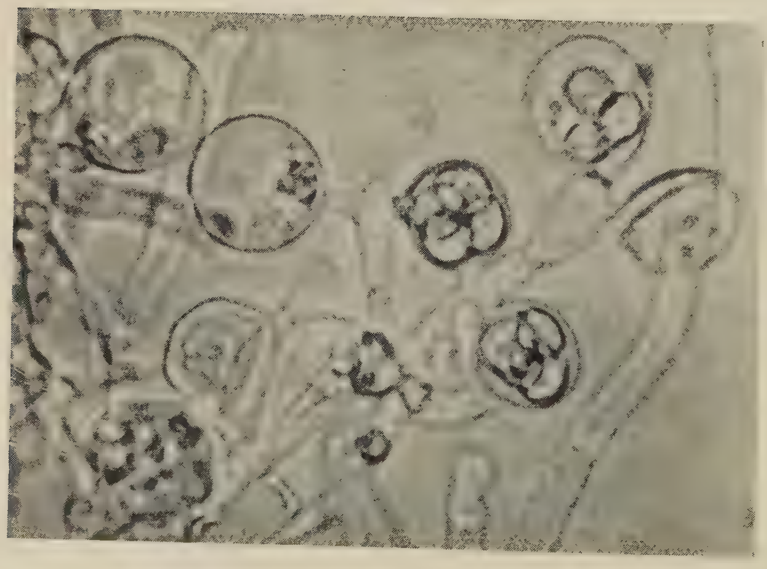

Fig. 4 — Aschi nel ceppo no. I

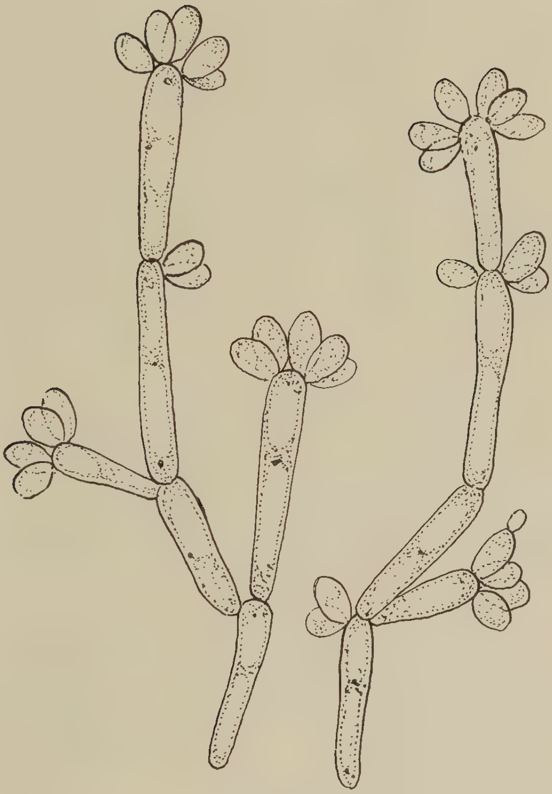

Fig. 5 — Aspetto dell' apparecchio blastosporico nei ceppi studiati

	fermentazione del					
	glucosio	galattosio	saccarosio	maltosio	lattosio	raffinosio
E. fibuliger sec. Lodder e Kreger van Rij	+ debole	—	+ debole	+ debole	—	⅓ o più
E. balearica	+ forte	—	+ debole	+ debole	—	?
ceppi 1-47-59	+ debole	—	+ debole	—	—	$^1/_5$ circa
ceppi 82-83-123	+ debole	—	+ debole	—	—	±
ceppo 127	+ debole	—	± debole	—	—	—

Come si debbono interpretare questi risultati?

Evidentemente tutti i ceppi isolati rispondono, con *E. fibuliger*, ad un'unica entità morfologica. Del resto anche i caratteri colturali, il quadro auxologico e gli altri secondari caratteri non mostrano differenze.

Ma ecco che differenze si incontrano, invece, nei riguardi delle proprietà fermentative.

Quale valore è da darsi a queste differenze?

Lodder & Kreger van Rij annotano che ,,the ability to ferment different sugars has been one of our main characters for species differentiation''; anche perchè — a parte gli altri caratteri fisiologici — ,,especially the fermentative properties are fairly stable''. Concetti, questi, universalmente accettati.

Ora, se noi disponiamo i nostri ceppi, insieme ad *E. fibuliger* tipo, secondo una crescente differenziazione di caratteri troviamo quanto segue:

	fermentazione:			
ceppo n° 127.	Gd	Sdd		
,, n° 82-83-123. . . .	Gd	Sd		
,, n° 1, 47, 59	Gd	Sd		R
E. fibuliger (tipo)	Gd	Sd	Md	R
E. balearica	Gf	Sd	Mf	?

(G = glucosio; S = saccarosio; M = maltosio; R = raffinosio; d = debole; dd = debolissimo; f = forte)

Il filo evolutivo (se così si può dire), partendo da individui a scarso patrimonio enzimatico ci porta dunque verso individui prov. visti di un relativamente ricco corredo di enzimi.

Evidentemente siamo in presenza di una entità morfologica zimologicamente molto dinamica.

Con tutto ciò, pur apparendo identici i caratteri morfologici, noi dobbiamo ammettere tale entità costituita di più specie se è vero che queste si distinguono, con generale criterio, in base alle proprietà fermentative.

Pertanto, nei nostri ceppi noi intravediamo, in quanto non fermenanti il maltosio, la specie descritta da Saito nel 1913 con il nome di *End. lindneri*, specie che verrebbe dunque riconvalidata sulla base dei nostri ceppi e degli attuali nostri reperti. Tanto per memoria sarà opportuno ricordare che la fermentazione del maltosio è stata saggiata sotto varie condizioni colturali; cioè, seminando con colture giovani o con colture vecchie; con colture già cresciute in mezzo maltosato; e finalmente in mezzi a vario pH senza mai conseguire, peraltro, traccia di fermentazione.

Finalmente, per quanto si riferisce ad *End. balearica*, la dimostrata energica fermentazione del glucosio non crediamo che rappresenti un carattere sufficiente alla istituzione di una nuova specie. Noi crediamo più giusta l'idea di considerarlo come un carattere varietale per cui, in adesione a tale idea, proponiamo di considerare *End. balearica* come *End. fibuliger* var. *energica*: Secondo KREGER-VAN RIJ *E. balearica* è da riportarsi a *Sacch.* (*Petasospora*) *rhodanensis* (comunicazione personale in data 24.XII.1958). Evidentemente questo riferimento trascura è carattere della formazione di vero micelio come SOCIAS e coll. descrivono, carattere che, al momento, è dato proprio di *Endomycopsis*.

Endomycopsis fibuliger (LINDNER) DEKKER ver. *energica* (SOCIAS et AL.) VER. et ZARD.
(Ex tipo differet energica fermentatione glucosii)

Riassunto

Da uve di paesi subtropicali (Brasile) sono stati isolati più ceppi di *Endomycopsis*. Il loro studio comparativo ha suggerito di riconvalidare *End. lindneri* SAITO passata da LODDER & KREGER VAN RIJ in sinonimia con *E. fibuliger*, e di istituire una nuova varietà di quest' ultima specie: *E. fibuliger*, var. *energica* n. var.

Summary

From grape must of a subtropical country (Brasil) some strains of *Endomycopsis* had been isolated. Their comparative study was suggestive to confirm again the species *E. lindneri* SAITO. Moreover, the same studies permitted us to establish a new variety: *E. fibuliger* v. *energica*, n. var.

Resumo

Foram isoladas algumas culturas de *Endomycopsis* de mosto de uvas cultivadas no Estado de S. Paulo, Brasil.

Os estudo comparativos dessas cepas sugeriram considerar como valida a especie *E. lindneri* SAITO, que LODDER & KREGER VAN RIJ dao como sinonimo de *E. fibuliger*.

Foi sugerido tambem instituir uma nova variedade, a *E. fibuliger* var. *energica*.

A NEW SPECIES OF SEPTORIA AND ITS ASSOCIATED ASCIGEROUS STAGE

by

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(5. XI. 1958)

In the course of his mycological collections, the writer encountered a leafspot on *Artemisia nilgirica*, Pamp. which on examination was found to be caused by a species of *Septoria*. Critical examination of the dead fallen leaves of the host also revealed a perithecial stage, which was later identified as a species of *Mycosphaerella* with the characteristic tufted asci, 2-celled hyaline ascospores and absence of paraphyses. These observations and regular association in the same infection spots of the two bodies were significant. Such association between species of *Septoria*, *Cercospora*, *Ramularia*, *Ascochyta* and other form-genera and the *Mycosphaerella* stage, have been previously noted by several authors, a detailed report of which has been made by Arx (1949) and Wolf & Wolf (1947). A detailed examination was, therefore, made of the two stages in permanent microtome sections, the results of which are presented in this note.

Conidial stage

A critical examination of the literature showed the record of two species of *Septoria* on the host genus, *Artemisia* viz. *Septoria artemisiae* Pass. F. Parm. on *A vulgaris* and *Septoria tabacina* Died. on *Artemisia* sp. by Saccardo (1905) and Sydow H. & P. & Butler (1916) respectively. A detailed comparison was, therefore, made between the two previously described species of *Septoria* and the present collection and is presented in the following table.

Comparison between Species of Septoria on Artemisia Sp.

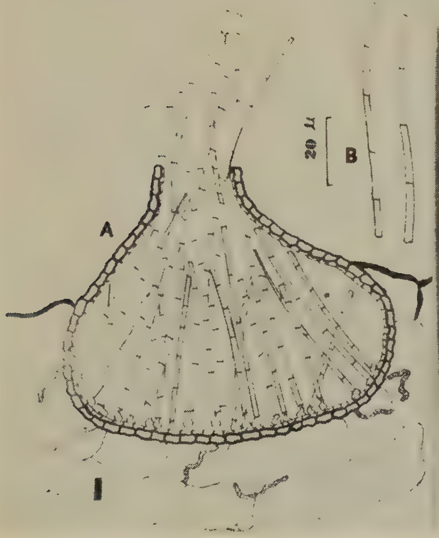
Species	Pycnidia	Conidia	Authority
S. artemisiae . .	—	30—33 = 1.5μ	Saccardo
S. tabacina. . .	75—100μ	50—62 = 2—2.5μ	Sydow & Butler
S. species	80—120μ	60—80 = 3—4μ	

It is clearly evident from the tabular statement that the present species is significantly distinct from the previously described species in all particulars having much larger conidia besides being collected on a hitherto unreported host. It may be stated that while *Artemisia vulgaris*, a previously reported host is typically a European plant, *Artemisia nilgirica* Pamp. is of Indian origin. The Indian collection is, therefore, presented as a new species with Latin diagnosis.

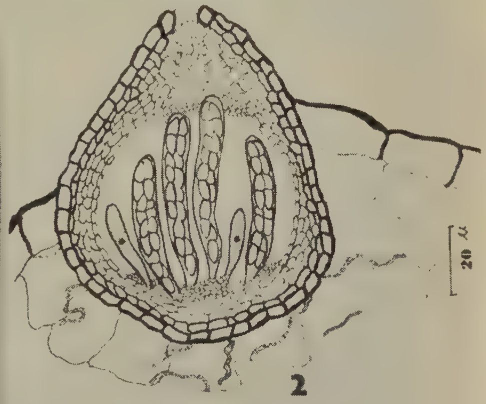
Septoria nilgiriensis TILAK, spec. nov.

Infectionis maculae amphigenae, brunneae vel fusce brunneae, circulares vel oblongae, diametientes 3—9 mm. Pycnidia ostiolata, ornata parietibus 2—3-seriatis cellulis pseudo-parenchymaticis, 3.4—8.5 μ crassis, 80—120 μ, immersa in textus plantae hospitis ostiolo extus eminente. Conidia hyalina, filiformia, multiseptata, plus minusve curvata, 60—80 = 3—4 μ, originem ducentia ex cellula basali tumescenti.

Lectus in foliis viventibus *Artemisiae nilgiricae* PAMP. ad Purandhar Fort, a S. T. TILAK, mense augusto 1958.



1. *Septoria nilgiriensis* (A) Section through pycnidium, (B) Conidia.



2. *Mycosphaerella artemisiae* - Section through perithecium.

Ascigerous stage

A perithecial stage was invariably found associated with the *Septoria* spots on the dead over-summered fallen leaves of this host, which was later identified as a species of *Mycosphaerella*. This association between the conidial and ascigerous stages in the same infection spots, is strongly suggestive of their genetical relationship. No inoculation work has, however, been carried out to prove this relationship in the present case. Since the ascigerous fungus has been collected on a hitherto unreported host, it is described as a new species of *Mycosphaerella* with Latin diagnosis.

Mycosphaerella artemisiae Tilak spec. nov.

Perithecia epiphylla, alte brunnea, globosa, crasse parietata, erumpentia, ostiolata, 100—120 = 80—95 μ. Asci fasciculati, clavati, astipitati, octospori, 51—68 = 11—15 μ. Ascosporae hyalinae, uniseptatae, biseriatae, 15—17 = 5—7 μ paraphysibus nullis.

In foliis emortuis *Artemisiae nilgiricae* Pamp. ad Purandhar Fort in India a S. T. Tilak mense augusto 1958.

The type specimens have been deposited in the herbaria of Commonwealth Mycological Institute, Kew, England and Indian Agricultural Research Institute, New Delhi, India.

The writer is grateful to Prof. M. N. Kamat for his guidance and interest during the course of these investigations, to Dr. S. P. Agharkar, Director, for facilities offered at this Laboratory and to Prof. H. Santapau for the Latin diagnosis of the new species. The writer also wishes to express his thanks to Dr. N. S. Venkatakrishniah, Plant Pathologist, Bangalore, for supply of literature.

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A NEW SPECIES OF CERCOSPORA AND ITS ASSOCIATED ASCIGEROUS STAGE

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(19.XI.1958)

In the course of his mycological collections, the writer encountered some shrubs of *Ehretia aspera* Willd. in the vicinity of Poona, which showed characteristic necrotic areas starting usually from the tip of the leaf and extending downwards (Fig. 1). In some of the leaves the infection started in two or more points which later coalesced covering a large area of the leaf. These prominent infection patches on microscopic examination were found to be incited by a species of *Cercospora* (Fig. 2). A more critical study of the infected patches also revealed an ascigerous stage, which was later identified as a species of *Mycosphaerella* with the characteristic tufted asci,

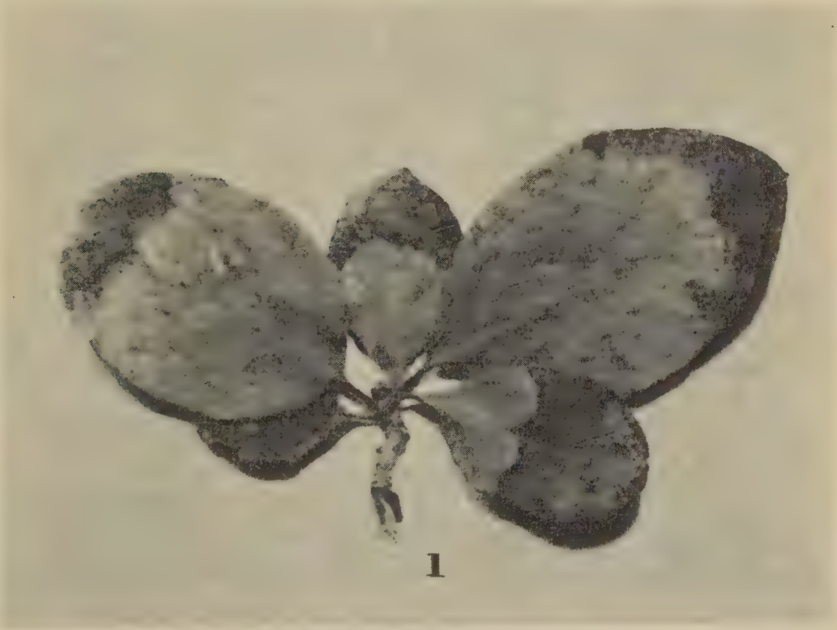
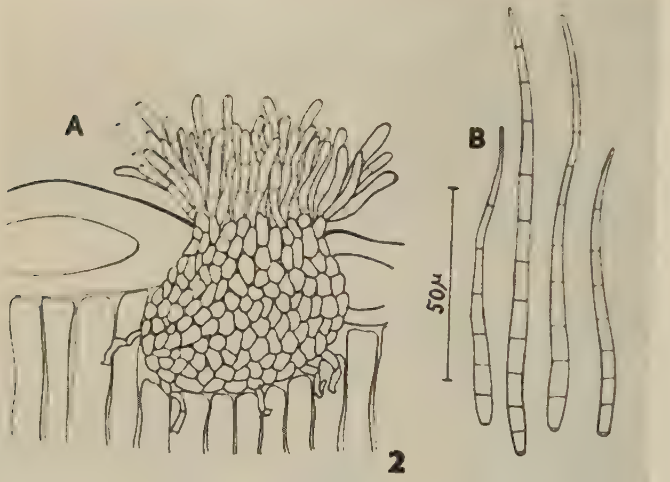


Fig. 1. Infected leaves of *Ehretia aspera* Willd.

2-celled hyaline, asymmetric ascospores and absence of paraphyses (Fig. 3). These observations and the constant and close association in the same infection patches, of the two fruit bodies were significant. Such associations between *Cercospora and Mycosphaerella* stages have been noted by many workers as reported by Arx (1949) and Wolf & Wolf (1949). A detailed examination was, therefore, made of the two stages on *Ehretia aspera* in microtome sections, the results of which are presented in this note.



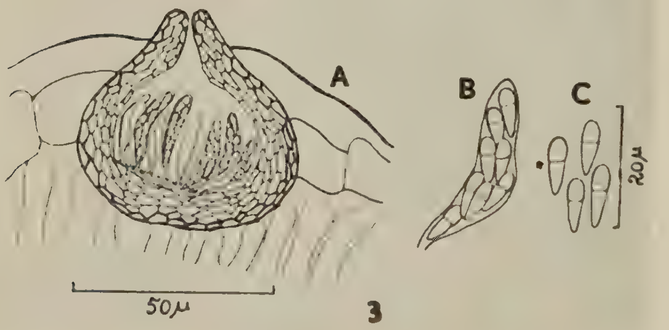


Fig. 2. *Cercospora poonensis*:
A. Stroma and Conidiophores. B. Conidia.

Fig. 3. *Mycosphaerella poonensis*:
A. Section through perithecium. B. Ascus. C. Ascospores.

Conidial stage

Togashi & Katsuki (1952) reported *Cercospora ehretiae* Togashi et Katsuki on the leaves of *Ehretia thyrsiflora* Nakai in Japan. A comparison between the Indian species of *Cercospora* on *E. aspera* and the species from Japan on *E. thyrsiflora* is presented in the following table:

Table I

Comparison between Japanese & Indian species of Cercospora on Ehretia species

Species	Stroma	Conidiophores	Conidia	Conidial septation	Authority
C. ehretiae	100 μ	2.5—3 × 10—25μ	2—3 × 30—70 μ	1—5	Togashi et Katsuki 1952
Indian sp.	30—50 μ	3—5 × 12—48 μ	2—4 × 50—125 μ	3—15	—

It is evident from the above tabular statement that the Indian species is significantly distinct from the one reported by Togashi in all essential features. The Indian collection is, therefore, presented as a new species of *Cercospora* with Latin diagnosis.

Cercospora poonensis Viswanathan spec. nov.

Infectionis maculae ut plurimum marginales, aggregatae, fusce brunneae; fructificationes vulgo hypophyllae; stromata bene evoluta, globularia, brunnea, compacta, 30—50 μ. Conidiophori dense fasciculati, pallide vel mediocriter brunnei, 0—3-septati, raro ramosi, haud geniculati, apice hyalino et hebete, 3—5 × 12—48 μ. Conidia hyalina, anguste obclavata vel cylindrica, recta vel suaviter curvata, 3—15-septata, ad basin truncata, ad apicem subacuta, 2—4 × 50—125 μ.

Typus lectus in foliis viventibus *Ehretiae asperae* Willd. ad Poona, in India, T. S. Viswanathan, mense septembri anni 1958.

Ascigerous stage

A mycosphaerella stage was invariably found associated with the above described *Cercospora* species as already stated. The constant and close association of the conidial and ascigerous stages in the same infection patches is strongly suggestive of their genetical relationship although no inoculation experiments were carried out to prove this association. Since the fungus has been collected on a hitherto unreported host, it is described as a new species of *Mycosphaerella*, with Latin diagnosis.

Mycosphaerella poonensis VISWANATHAN spec. nov.

Perithecia vulgo hypophylla, fusce brunnea, 50—70 μ, ostiolo erumpente, magnit. 8—15 μ. Asci fascuculati, clavati, octospori, 20—27 × 7—9 μ, aparaphysati. Ascosporae biseriatae, hyalinae, semel septatae, asymmetricae, 6—10 × 1.5—3 μ.

Typus lectus in foliis viventibus *Ehretiae asperae* WILLD. ad Poona, in India. T. S. VISWANATHAN, mense septembri anni 1958.

The type specimens have been deposited in Herbarium Cryptogamae Indiae Orientalia, New Delhi, India and the Herbarium of the Commonwealth Mycological Institute, Kew, England.

The author wishes to express his grateful thanks to Prof. M. N. KAMAT for guidance, to Dr. S. P. AGHARKAR, Director, for laboratory facilities, to Rev. Father H. SANTAPAU for Latin diagnosis and to Sri. V. D. VARTAK, Fergusson College, for his help in the identification of the host.

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A DIAGNOSTIC DIAGRAM OF MYCOSES AND MYCETES

by

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(14. XI. 1958)

Mycoses of the skin and internal organs are steadily gaining increasing importance. Investigations and observations in tropical and subtropical areas have shown that certain mycoses are met with in many more places than it had been realized before. Travelling being more and more on the increase it may be expected that mycoses spread to areas where they were unknown in the past.

For every physician, in particular for the physician working or intending to work in tropical or subtropical countries, it is therefore imperative to be acquainted with the field of Medical Mycology, best being already introduced into the subject during his studying years. To help him to become more experienced in the diagnosis of mycoses, a "Diagnostic Diagram" has been worked out as a visual aid. In this "map" the most important mycoses are connected by a network of roads. The characteristic forms of fungi are represented in drawings.

The general survey of mycoses affecting man and their causative organisms, shown in the folding ,,Diagnostic Table", represents a synthesis of clinical and mycological findings. The table has been worked out with the aim of facilitating specific mycological diagnosis by relatively simple means. Whenever there are facilities for laboratory examinations, such a map may allow a rapid survey of the tests leading to diagnosis and help to avoid unnecessary work. For the general practitioner, who usually sees the mycotic patient first, it may be means of orientation in the selection of investigation methods. The table may fulfil its purpose if it serves as a guide and can give any suggestions.

It may be helpful to discuss briefly where in the great realm of fungi those species can be found that may be pathogenic to man and animal. Are they related to the edible mushrooms, do they closely belong to the molds, of which *Penicillium notatum* has become so famous? May there be connections with the ergot of rye, still an indispensible drug? Are the man-pathogenic fungi relatives of plant-pathogenic species, such as we know them as the dreaded causes of plant epidemics, e.g. mildew, fruit-tree canker, wart disease of the potato, fruit and root rot, smut, rust or scab?

In the "Natural System", fungi are classified according to the structure of their sexual reproductive forms; but only few of the fungi pathogenic to man and animal can be classified with the natural system; they are:

1. *Mucor* and *Rhizopus*, belonging to the Phycomyceteae, because their hyphae are not septate. Even if the isolation of the fungus has been unsuccessful, they can be recognised when the histological specimen clearly shows non-septate hyphae. Among the phycomycetes we find numerous plant-pathogenic species, for example the cause of false mildew (*Peronospora*).
2. *Allescheria boydii* (imperfect form: *Monosporium apiospermum*) and *Piedraia hortai*, forming ascospores and, therefore, belonging to the Ascomyceteae, also *Aspergillus* and *Penicillium*. Some authors also group *Coccidioides immitis* and *Rhinosporidium seeberi* with the Ascomyceteae, but a proof of this relationship has not yet been offered. Ascomyceteae further include many organisms known to be causes of plant diseases, for example, the causal organism of powdery mildew, ergot of rye, and the species of Sclerotinia (imperfect form: *Monilia*) as a cause of fruit rot.

Many thousand species of fungi, including most of those pathogenic to man and animal, do not form sexual spores and, therefore, cannot find a place in the natural system. These fungi multiply only vegetatively. Because of their incomplete cycle of development they are termed "Fungi imperfecti". For the classification and identification of these fungi an additional artificial system has been elaborated. As distinguishing features serve both the asexual reproductive forms (macroconidia and microconidia) and morphological and physiological properties, such as pigment formation, sugar fermentation, assimilation, amongst others.

The table shows the facts of interest for medical mycology about the artificial system of "Fungi Imperfecti":

CLASSIFICATION OF FUNGI IMPERFECTI

(The generic names given in small Capitals are found in the Folding Table)

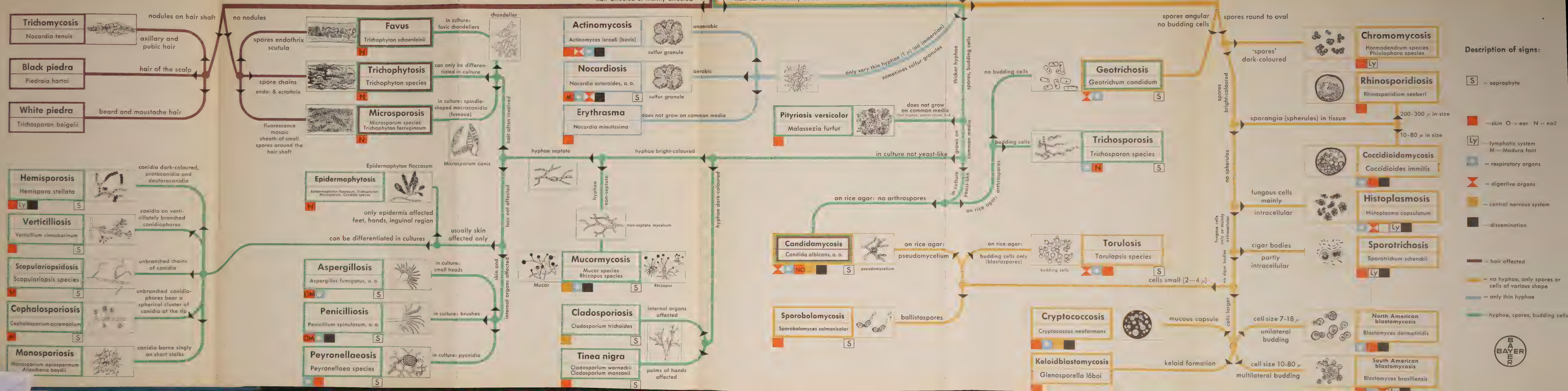
1. Order: Sphaeropsidales
   The asexual spores are formed in special containers, the pycnidia.
   Facultatively pathogenic: PEYRONELLAEA.

2. Order: Melanconiales
   The asexual spores are formed in cushion-like aggregates, called acervuli.

3. Order: Moniliales (= Hyphomycetes)
   The asexual spores are not formed in either pycnidia or acervuli, but develop free on the mycelium, either direct on the hyphae or on special stalks (conidiophores).

Diagnostic Table, according to Hans Rieth, M. D., Dermatology Clinic Hamburg University, Hamburg-Eppendorf (Germany)

MYCOSES


hair affected or mainly affected

hair not or not mainly affected

by direct microscopic examination

no hyphae, only spores or cells of various shape

nodules on hair shaft

no nodules

Trichomycosis
Nocardia tenuis
axillary and pubic hair

Black piedra
Piedraia hortai
hair of the scalp

White piedra
Trichosporon beigelii
beard and moustache hair

spores endothrix scutula

Favus
Trichophyton schoenleinii
N
in culture: favic chandeliers
chandelier

spore chains
endo- & ectothrix

Trichophytosis
Trichophyton species
N
can only be differentiated in culture

fluorescence
mosaic
sheath of small spores around the hair shaft

Microsporosis
Microsporum species
Trichophyton ferrugineum
N
in culture: spindle-shaped macroconidia (fuseaux)
Microsporum canis

hair often involved

hair not affected

Epidermophyton floccosum

Epidermophytosis
Epidermophyton floccosum, Trichophyton Microsporum, Candida species
N

only epidermis affected
feet, hands, inguinal region

usually skin affected only

can be differentiated in cultures

Hemisporosis
Hemispora stellata
Ly S
conidia dark-coloured, protoconidia and deuteroconidia

Verticilliosis
Verticillium cinnabarinum
S
conidia on verticillately branched conidiophores

Scopulariopsidosis
Scopulariopsis species
M S
unbranched chains of conidia

Cephalosporiosis
Cephalosporium acremonium
M S
unbranched conidiophores bear a spherical cluster of conidia at the tip

Monosporiosis
Monosporium apiospermum
Allescheria boydii
conidia borne singly on short stalks

skin and internal organs affected

Aspergillosis
Aspergillus fumigatus, a. o.
OM S
in culture: small heads

Penicilliosis
Penicillium spinulosum, a. o.
OM S
in culture: brushes

Peyronellaeosis
Peyronellaea species
S
in culture: pycnidia

Actinomycosis
Actinomyces israeli (bovis)
sulfur granule
anaerobic

Nocardiosis
Nocardia asteroides, a. o.
M S
sulfur granule
aerobic

Erythrasma
Nocardia minutissima
does not grow on common media

only very thin hyphae (1 μ) (oil immersion)
sometimes sulfur granules

hyphae septate

hyphae bright-coloured

hyphae non-septate

non-septate mycelium

hyphae dark-coloured

Mucor

Mucormycosis
Mucor species
Rhizopus species
S
Rhizopus

Cladosporiosis
Cladosporium trichoides
S
internal organs affected

Tinea nigra
Cladosporium werneckii
Cladosporium mansonii
S
palms of hands affected

Pityriasis versicolor
Malassezia furfur
does not grow on common media
short hyphae, spores round 3–8 μ

thicker hyphae

spores, budding cells

grows on common media

in culture not yeast-like

in culture yeast-like

on rice agar: no arthrospores

on rice agar: arthrospores

Candidamycosis
Candida albicans, a. o.
NO S
pseudomycelium
on rice agar: pseudomycelium

Sporobolomycosis
Sporobolomyces salmonicolor
S
ballistospores

no budding cells

Geotrichosis
Geotrichum candidum
S

budding cells

Trichosporosis
Trichosporon species
N S

on rice agar: budding cells only (blastospores)
budding cells

Torulosis
Torulopsis species
S

cells small (2—4 μ)

spores angular no budding cells

spores round to oval

'spores' dark-coloured

Chromomycosis
Hormodendrum species
Phialophora species
Ly

Rhinosporidiosis
Rhinosporidium seeberi

spores bright-coloured

sporangia (spherules) in tissue

200-300 μ in size

10-80 μ in size

Coccidioidomycosis
Coccidioides immitis

no spherules

fungous cells mainly intracellular

Histoplasmosis
Histoplasma capsulatum
Ly

fungous cells only or mainly extracellular

cigar bodies partly intracellular

Sporotrichosis
Sporotrichum schenckii
Ly

no cigar bodies

cells larger

Cryptococcosis
Cryptococcus neoformans
mucous capsule

cell size 7-18 μ
unilateral budding

North American blastomycosis
Blastomyces dermatitidis

Keloidblastomycosis
Glenosporella lôboi
keloid formation

cell size 10-80 μ
multilateral budding

South American blastomycosis
Blastomyces brasiliensis

Description of signs:

S = saprophyte
🟥 = skin O = ear N = nail
Ly = lymphatic system M = Madura foot
▨ = respiratory organs
⧗ = digestive organs
🟧 = central nervous system
⬛ = dissemination
▬ = hair affected
▬ = no hyphae, only spores or cells of various shape
▬ = only thin hyphae
▬ = hyphae, spores, budding cells

1. Family: **Cryptococcaceae** (imperfect yeasts)
   Blastospores (budding cells), pseudomycelium, sometimes true mycelium or arthrospores are seen. Include *Cryptococcus*, *Torulopsis*, *Candida*, *Trichosporon* and *Rhodotorula*.
2. Family: **Sporobolomycetaceae**
   Blastospores and ballistospores are formed. Facultatively pathogenic: *Sporobolomyces*
3. Family: **Moniliaceae** (= Mucedineae)
   Mycelium and conidiophores are hyaline or bright in colour. Include many genera, for example: *Trichophyton*, *Microsporum*, *Epidermophyton*, the yeastlike fungi *Geotrichum*, *Blastomyces*, *Glenosporella* (*Loboella*), *Sporotrichum* and *Histoplasma*, also the molds *Aspergillus*, *Penicillium*, *Hemispora*, *Verticillium*, *Scopulariopsis*, *Cephalosporium* and *Monosporium*
4. Family: **Dematiaceae**
   Mycelium and conidiophores are dark, the spores bright or dark in colour. Include many genera, e.g. *Hormodendrum*, *Phialophora*, *Cladosporium* and *Madurella*.
5. Family: **Stilbellaceae**
   The conidiophores form so-called coremia (= small fruit trees).
6. Family: **Tuberculariaceae**
   The conidiophores are connected to form clusterlike aggregates, so-called sporodochia.

4. Order: Mycelia sterilia
With these are grouped the fungi which do not form spores but hyphae only.

Addendum: Actinomycetales

Following old usage, Actinomycosis and nocardiosis are usually included in mycological systems, although their causative organisms are closely related to mycobacteria. The Order Actinomycetales is divided into two families:

1. Family: **Actinomycetaceae**
   include two genera: *Actinomyces* and *Nocardia*.
2. Family: **Streptomycetaceae**
   with the two genera: *Streptomyces* and *Micromonospora*.

Dermatophytes

The dermatophytes, most known skin-pathogenic fungi, can be divided in three genera:

1. *Trichophyton* (including *Ctenomyces* and *Achorion*)
2. *Microsporum* (syn. *Sabouraudites*)
3. *Epidermophyton.*

Repeatedly, the dermatophytes have been claimed to belong to the Ascomyceteae instead to the Fungi Imperfecti. In 1880, EIDAM isolated from decaying bird feathers a fungus whose imperfect stage resembled a trichophyton, while the perfect reproductive forms were typical ascospores. He called this fungus *Ctenomyces serratus.* Several other authors later claimed to have seen similar ascospores in *Trichophyton* species, but it is impossible to reproduce these findings with certainty. If actually the dermatophytes can form ascospores, their classification with the natural system would be possible.

At present, the various linguistic areas are still using various classifications of the dermatophytes, but the differences are disappearing more and more, and it is hoped that a final agreement will be achieved. The qualified tribunal for discussing a future systematic classification is The International Society for Human and Animal Mycology (Secretary-General: Prof. Dr. R. VANBREUSEGHEM, Tropical Institute, Antwerp, Belgium). The meeting of the members on the occasion of the Sixth Congress on Tropical Medicine and Malaria in Lisbon (September 1958) was very useful to discuss various points of view. It was observed that personal contact of all interested mycologists is the beginning of high activity and good cooperation. After a period of preliminary and provisional actions, it seems to approach the "golden age" of human and animal mycology.

REVIEW OF WORKS ON MEDICAL MYCOLOGY PUBLISHED IN THE USSR BETWEEN

1946—1956

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The science of mycology became a separate branch of medicine in the USSR having been greatly enriched with scientific and practical achievements in the control of fungous diseases which were widely spread in pre-revolutionary Russia.

The main principles of scientific and practical research in the field of Soviet mycology are: close relation and correlation of processes and phenomena, and the wholeness of the macro-organism as related to the great significance of the central nervous system in the appearance, development and outcome of fungous diseases.

The peculiarity of investigations in the field of morphology and biology of pathogenic fungi was to establish the variability of dermatophytes, and prove that it is part and parcel of the processes of the development of fungi, a manifestation of their vital activity. It has been demonstrated that environment in the broad sense of the word determines the appearance of new species, types and genera of dermatophytes. It has also been established that by selecting appropriate conditions it is possible to actively interfere in the development of dermatophytes and direct their variability along the channels applicable to the needs of health protection.

Materials on the variability of dermatophytes, the knowledge of characteristic peculiarities of their species make it possible to solve complicated epidemiological issues with a greater degree of certainty and evaluate from a new viewpoint the mixed and secondary infections, the dynamics and peculiarities of the fungal flora.

The specificity of a study of the macro-organism consists in the determination of an exceedingly important role of the individual state of the patient in the pathogenesis of fungous diseases, in the diversity of clinical manifestations of a disease and in the evaluation of the efficiency of therapeutical measures.

Investigations carried out along the mentioned lines provided new, pathogenetic principles for the treatment of fungous diseases; they demonstrated the necessity of an all-round activation of the protective reactions of the organism and its various systems.

The revision of the methods previously used in treating fungous diseases revealed certain faults in the old principles of anti-parasitic therapy which counted on the death or ousting of the fungus; it showed the efficiency of treatment combining somatic, antiparasitic and desensitizing therapies especially in regard to chronic and visceral mycoses of man.

The dispensary principles in the treatment and prophylaxis of patients based on scientific investigations are characteristic of Soviet mycology in the control of fungous diseases.

Systematic and all-embracing examinations of people for the detection of these diseases, finding the sources of infection and determining the way it spreads, anti-epidemic processing of the source of fungous diseases, free qualified medical aid, etc. — all of which conditions provide for scientific and practical achievements in the control of fungous diseases and open up new possibilities for the elimination of dermatomycoses as is the case in some of the Republics of the USSR.

The vast territory of the Soviet Union and the diversity of climatic conditions and nationalities account for the diversity of fungous diseases, i.e. the incidence of the latter in various geographical regions, the peculiarities of fungi infections in urban and rural localities, etc.

Dermatomycoses occupy in the USSR the prevalent place as to the spread of infection and its incidence among fungous diseases. They can be encountered in southern and northern regions of the country, in urban and rural localities and not so often among nomadic tribes and mountaineers. Dermatomycoses, especially favus were widely spread in pre-revolutionary Russia when registration of these diseases or any prophylactic measures were unknown.

The successful elaboration of epidemiological measures and prophylaxis of dermatomycoses in regard to the conditions of life and work and mainly the dispensery treatment of the population made it possible to bring about the sanitation of the old foci of infection and decrease the incidence of new fungous diseases.

By the time the Great Patriotic War started in 1941 fungous diseases were not known in children's boarding schools and were encountered rarely among school-children. Chronic forms of dermatomycoses could be detected among adults mainly in rural localities since rural regions were not very well controlled by prophylactic examinations. Trichophytosis occupied the first place in prewar years as regards its incidence. More often than not *Tr. violaceum* was its causative organism; *Tr. crateriforme* was not so often encountered and *Tr. gypseum, Tr. acuminatum* were quite rare; *Tr. sulfureum, Tr. ochraceum, Tr. rosaceum* were described as isolated cases only.

The second place before the war was occupied by microsporosis (usually caused by *M. lanosum*) in man, and also in cats and dogs;

M. equinum was encountered among horses. *M. ferrugineum, M. xanthodes* were found as separate and very rare cases. Favus was detected before the war exclusively in those places where it had been spread extensively prior to the revolution, i.e., in warm regions. The *A. Schönleini* used to be almost the sole causative organism of favus, whereas *A. Quinckeanum, A. violaceum* were quite rare and were associated with diseases of domestic animals and rodents.

The great Patriotic War drastically changed the situation in the field of fungous diseases. Mass movements of the people, intervention of vast territories by the enemy, destruction of medical institutions, hard conditions of life and work and also a certain slackening of attention as regards dermatomycoses — all these conditions lead to a sharp rise in the incidence of dermatomycoses on the territory which was at that time occupied by the fascists, led to the spread of fungous diseases almost on the whole territory of the USSR when the people were re-evacuated after the enemy had been driven out of the country.

After the war the correlation between fungous diseases also changed. For a number of years the first place among them was occupied by microsporosis caused by *M. ferrugineum,* whereas conditions caused by *M. lanosum* were pretty rare. In some places one could encounter *M. audouini.*

As regards trichophytons, the first place after the war was occupied by *T. violaceum,* then by *T. crateriforme* with the later appearance of *E. rubrum* which showed a tendency towards a wider spread.

The construction of the system of control and prophylaxis of dermatomycoses, the organisation of dispensary services, field expeditions to the foci of microsporal diseases on the territory previously occupied by the Germans — all these measures allowed us to eliminate the epidemic spread of microsporosis and reach the prewar level as regards the incidence of fungous diseases.

In 1957 a progressive decrease of dermatomycoses was noted throughout the country. We were then faced with concrete tasks of eradicating favus and microsporosis primarily where the spread of those infections was due to ecological factors.

There are not tangible shifts in the decrease of epidermophytosis. It is interesting to point out that its causative organisms are still *E.* KAUFMAN-WOLF and as very rare isolated cases *E. inguinale.* At the same time we more often encounter lesions of the feet, of toe nails and also lesions of the hands — all of them caused by *E. rubrum.* With the same condition are connected chronic lesions of the smooth skin of the body and extremities which are very difficult to cure, and also very rare lesions of the hair on the head and body (endotrix type). If we take into account the absence of 100 % cultural diagnostics of epidermophytic diseases, their overall registration does not exist either. Same is true of the registration of diseases caused by *E. rubrum.*

Wide application of antibiotics and failures connected with the non-rational utilisation of the latter drew the attention of physicians to diseases caused by the fungi *Candida* which made it possible to detect different lesions of the skin, mucous membrane, internal organs and reveal septicemic processes.

In cases when yeast-like fungi and candidoses are widely spread against the background of serious infectious and non-infectious diseases, the registration of this group of diseases cannot be considered as satisfactory and reflecting the real state of affairs in the given field. At any rate, diseases caused by the *Candida* fungi and their complications are detected now more often than 10—15 years ago.

Profound and systemic lesions of the type of American blastomycosis are not known in the USSR.

Quite recently scattered cases of coccidioidomycosis were described. Epizootic lymphangitis — cryptococcosis of the animals is a rare condition. Sporotrichosis has not been found in the USSR. Actinomycosis is, as it used to be, sporadic. Aspergilloses, penicillioses and other mycoses caused by the fungi perfecti are rare.

In this paper works are reviewed published only in the periodical press. We do not touch on communications in the form of reports at meetings, and conferences, we do not touch here on candidates' and doctors' dissertations, etc., or summaries of works of certain research and clinical institutions.

Nevertheless, works reviewed here characterise the general trend of Soviet medical mycology, the results of clinical and laboratory investigations of fungous diseases, their epidemiology and organisation of measures of their control.

First to be discussed here are dermatomycoses which are extensively studied in our country.

I. Dermatomycoses and Dermatophytes

1. The species content of dermatomycoses.

The species content of dermatomycoses is rather uniform in its main representatives (35, 50, 72, 113, 135, 143, 144, 163, 178). However, it underwent considerable changes in the postwar years. Wide spreading of *M. ferrugineum* and some increase of zoophylic Trichophytons and particularly of *T. gypseum*, *T. faviforme* (35, 106, 152, 206) took place. The finding of a few zoophylic trichophytons in warm and sunny regions of the country, the absence of diseases caused by *M. lanosum* in those regions are usually connected with the unfavourable influence of large and strong insolation on the propagation of the above dermatophytes (158).

Mixed microfloras, and two different dermatophytes found in the foci of infection of one and the same patient have been described (57, 178).

M. iris, M. equinum, A. gallinae, A. violaceum, E. rubrum have been recently described as uncommon dermatophytes (35, 44, 146, 186).

The microflora on the Pamir mountains proved to be quite common. The following species are described amongst its dermatophytes: *T. violaceum, T. crateriforme, A. Schönleinii.* From some patients it has been possible to isolate the cultures of *T. violaceum* and *A. Schönleinii* (60).

A sharp drop in the incidence of new findings and the disappearance of *M. ferrugineum* was noted recently in a number of localities (196).

Changes in the species content of dermatophytes or the appearance of the latter in this or that region are usually ascribed to mass movements of the population during the war and immediately there after (92). The normalisation of the species content, the disappearance of uncommon dermatophytes, a drop in the morbidity rate — all that is a result of overall medical and prophylactic measures (53, 64, 93, 94) providing for the practical eradication of favus in some regions of the country (113).

2. Morphologo-biological peculiarities.

Works on the biology of dermatophytes bear on nutrition, selection of rational media, characteristics of antibiotic products of their vital activity and also on the possibilities of the development of some of them in sterile and non-sterile conditions.

Comparative study of the nutrient value of various carbohydrates in synthetic media for dermatophytes such as *T. gypseum, M. lanosum, E.* Kaufmann-Wolf demonstrated a difference in the intensity of the uptake of various types of carbohydrates; mannites proved the most suitable for all experimental cultures; the uptake of glucose, maltose and glycerine was not as good; the sucrose and galactose uptake was very weak; the starch and dulcin uptake was almost nil. The best growth of dermatophytes was noted on a medium to which 4—6 % of an easily assimilated carbohydrate was added. However, further increase in the content of carbohydrates had no favourable effect. A study of 13 different combinations of carbohydrates in a synthetic medium demonstrated that the combination of glucose and mannites, 3 % of which were added to the medium, was the most suitable for the development of dermatophytes (66).

Nitrogen sulphur, phosphorus, sodium, magnesium, calcium and chlorides proved indispensable chemical elements for the vital activity of dermatophytes; the nitrogen up-take by dermatophytes in the form of ammonium compounds is especially good (67).

On the basis of the registration of the biomass accumulation and the speed of the development of dermatophytes, out of 35 synthetic media of different content it has been possible to select the best suitable medium for the study of metabolism of dermatophytes and their biochemical activity (68).

It has been established that the mycelium of Penicillia, being a byproduct of certain biotechnological processes, can be used in microbiological practice as the base for nutrient media for the growth of various types of saprophytic and pathogenic fungi especially dermatophytes, and also various bacteria (71).

A study of the lipolytic activity of cultures *M. lanosum, T. gypseum, T. violaceum, A. Schönleinii* of various *Candida* and *Cryptococcus neoformans* showed that fungi disintegrated the fat of the subcutaneous cell tissue of man and pork lard in a synthetic medium. The disintegration of fats was the most active in the cultures *T. gypseum* and *M. lanosum* and much weaker in the cultures *A. Schönleinii* and *T. violaceum*. Weak activity was noted in the culture of various *Candida* and *Cryptococcus neoformans*. Adding peptone to a nutrient medium increases the disintegration of fats by the fungi, whereas the addition of maltose slowed the process down (188). A comparitive study of the applicability of corn, soya and Sabouraud media for the detection of the pigments in the cultures *E. rubrum* demonstrated the obvious advantage of the corn medium compared with others. The red pigment in the cultures *E. rubrum* appeared on the 9—10th day and in the cultures *E.* KAUFMANN-WOLF the reverse side of the colonies retained brown colour (177).

To study the processes of metabolism in fungi and bacteria, cultivated at low-grades in laboratory conditions a special fermentor has been evolved (see diagram) which proved very useful in practical work. It made it possible to manipulate material without contaminating it with fungi or bacteria (199).

As a result of a comparitive study of the antagonistic activity of dermatophytes the main stages of the study of antibiotic products of dermatophytes vital activity were described as well as the methods of their titration. The most active proved the following: *T. gypseum, T. rubrum, E.* KAUFMANN-WOLF, *M. ferrugineum* (91).

A characteristic of the antibiotic products of the vital activity of dermatophytes has been drawn up: Trichomycin received from the cultures *T. gypseum* (46), phytorubin from the cultures *T. rubrum* (96), ferrugin from the cultures *M. ferrugineum* (102), and also an active substance from the cultures *E.* KAUFMANN-WOLF (198), and phytins from the cultures of certain fungi (191).

A number of papers describe materials bearing on the peculiarities of the development of *M. lanosum* in a sterile medium (143), on the possibility of the development of fungi from pathological material on slices of non-sterilized carrots, beets and potatoes (63). The vegetation and considerable changes of dermatophytes in sterile and non-sterile media has been described. It has been also established that pathogenic properties of *M. lanosum* and *T. gypseum* are better preserved in sterile conditions than otherwise (170).

The main tasks in the study of biochemical peculiarities of dermatophytes and the possibilities of their natural existence have been outlined in the works under review (90).

3. Viability of dermatophytes, the questions of disinfection. The viability of dermatophytes was studied both in regard to the effect of various physico-chemical and biological factors and also in regard to the storage of pathological materials and cultures in laboratory conditions. The resistance of *M. equinum* and *T. equinum* towards certain physical factors was studied on the articles of harness, brushes, ropes — all of them having been contaminated with the cultures of the above dermatophytes.

It turned out that freezing does not kill the fungi. The irradiation of the fungi with sun rays during 36—40 hours has a killing effect on them as well as the action of dry heat at the temperature of 115° C during 35 min. The same effect is attained by keeping the fungi in a paraformaline chamber during 55 minutes at the temperature of 60° C. The washing off of fungi in the cultures occurs much quicker (211). The killing effect of the sun and heat was noted on the causative organism of favus in pathological material (204, 205).

As regards chemical factors the following ones had a fungicidal action in respect to *M. ferrugineum* in the cultures and pathological material: chlorinated water, 2 % formaline solution and also the solutions of washing soap and ash liquor, the latter being most effective at the temperature of 50° C (70).

The same killing effect on various dermatophytes in cultures and pathological material is exerted by 10—30 % solutions of acetic acid especially when the cultures were not washed after the seeding of new material. In view of the above statement it is recommended to use 25—30 % of water solutions of acetic acid for emergency disinfection of certain articles and barbers' implements which were used on patients suffering from dermatomycoses (2).

A comparative study of the fungicidal properties of certain tropical plants demonstrated a certain delay in the development of the cultures of dermatophytes under the action of magnolia flowers, noble laurel, cherry laurel, etc. The fungicidal action of alcohol tinctures is more manifest than that of water solutions. Ether oils of the investigated plants does not have any fungicidal action and on the contrary, promotes the development of fungous cultures (3).

An active entity from the cultures of one of actinomycetes damaging the cultures of *A. Schönleinii* and *T. gypseum* has been described. Active substances are destroyed by thermic sterilization and caught in the Zeits filters (129). The symbiotic and antagonistic action of pathogenic fungi and bacteria isolated in the foci of mycotic lesions has been noted (190).

The study of various concentrations of radioactive phosphorus from 1 to 200 mCu of the sodium salt in 1 ml of the Sabouraud medium showed that there was no damaging effect on epidermophytons. A certain slow down in their growth was noted after the addition of 500 mCu. However, the last dose of the isotope is so big that it can hardly be used in medical practice (126).

On the basis of a comparative study of the fungicidal activity of chloromine solutions and thermic effects it has been demonstrated that the latter have more advantages in practical use. The same work describes conditions and the regimen of chemical and thermic effect on the fungi (212).

A number of papers touch on the question of disinfection in cases of fungous diseases (118), sterilisation of bed linen (83), sheds for the livestock (155), on the application of various chemical drugs as fungicides (84, 86, 130, 187), on simple methods of disinfection in cases of dermatomycoses, etc. (165).

A study of the viability of dermatophytes on extensive material, when pathological samples were stored for a long time, demonstrated an amazingly long viability and pathogenity of *M. lanosum*, even as long as 5 years (120), and of various strains of *T. equinum* as long as 7 years (211).

The preservation of the pathogenity of *M. lanosum* and *T. gypseum* in the experiments of guinea-pig hair contamination was registered as long as 2 years (169). *M. ferrugineum* preserved its vital activity in the hair for 26 months (159).

4. The variability of dermatophytes.

Quite a number of papers have been dedicated to this subject. They touch on the peculiarity of manifestations of variability of dermatophytes in the cultures of *M. lanosum* (157), *M. ferrugineum* (159, 197), *T. gypseum* (157), *T. violaceum*, *T. faviforme*, *A. Schönleinii* (87), *E. rubrum* (186) and of certain yeasts, mildews and bacteria (55, 179).

The variability of dermatophytes was studied under the action of various sources of nutrition, different degrees of aeration, physical factors, medical drugs (45, 157), different acidity from pH 5.0 to 8.0 of nutrient media (119), under the effect of the vital activity products of pyococcus, diphtheroids, intestinal bacteria (95), and also in mixed cultures. The study aimed at establishing the fact of the inhibitory action of one species on the other (157). The adaptive variability of yeasts towards anticeptics (55) and the induced variability of antagonistic properties of yeasts, mildews and bacteria (179) have been studied.

As a result of the experiments mentioned above different variants have been obtained which differ from typical initial cultures in size and shape of colonies, pigmentation, the reaction to the nutrient media, peculiarities of fruiting, intensity of growth and pathogenic activity.

Clinical parallels have been established between the variants obtained experimentally and rare cultures recovered from patients

(9, 87, 149). An opinion has been expressed as to the genetic affinity between *T. violaceum* and *A. Schönleinii* and also on the significance of the latter for laboratory and clinical work (9, 97, 131). The resistance of uncommon variants of *A. Schönleinii* has been studied in hundreds of generations on common media. The same works described a long term (up to 10 years) preservation of uncommon cultures of the following variants: craterioform, cerebriform and gypsum-like obtained at one time from the typical stitch-like cultures of *A. Schönleinii* of unicellular origin (88).

Cultural types of growth, polymorphism and variability of *M. ferrugineum* (149, 159, 197) and *E. rubrum* (186) have been also described.

Certain perspectives have been outlined in the further study of the variability of dermatophytes (9, 87, 90).

5. Pathogenesis of dermatomycoses.

This issue has been dealt with in a number of papers. The general trend is to stress the importance of the state of macro-organism, its hormonal functions, the degree of vitamin supply, activity of tissue ferments and the state of specific and non-specific protective reactions of the organism (7, 11, 89). The works in question also point out the role and significance of the nervous system in the pathogenesis of mycotic diseases and the peculiarity of their clinical manifestations, the graveness of the course of disease and successes in the treatment. The individual state of the patient has been given special place in these works in regards to the pathogenesis of mycotic diseases.

Special attention is paid to the role of the nervous system in the pathogenesis of chronic Trichophytia. Stress is being laid on the reflex mechanism of eruption which is confirmed by the symmetrical and constant character of itching in the foci of the lesions (20). The author ascribes the development of this disease to trophic, vegetative and vascular lesions; he also describes the resistance of the disease to the common methods of treatment.

The impairment of the sexual glands functions found in cases of chronic trichophytia testifies to the significance of hormonal factors in the pathogenesis of the disease and gives the physician good reasons to prescribe endocrinal drugs and general somatic treatment (36).

The study of the amino-acid content of sweat by the method of paper chromatography made it possible to establish wide quantitative fluctuations in the content of aspargic and glutamic acids, serine, trenonine, alonine, valine and meteonine in the patient (141).

Quite a considerable amount of sugar is contained in the sweat of patients suffering from dermatomycoses. In conditions of high humidity and evaporation the content of sugar sedimentation on the soles of feet of dermatomycotic patients shows optimal quantities for the development of fungi (47).

The reactivity of the organism proved to change in cases of eczematous epidermophytosis (69). The works in question have shown the role of fungous lesions of feet in the pathogenesis of relapsing erysipelas of the lower extremities (207).

Clinical peculiarity of microsporosis caused by *M. ferrugineum* and peculiarities of the causative organisms in pathological material have been studied on experimental animals (49).

Experimental onychomycosis has been induced in guinea-pigs when contaminated with *E. rubrum* (infection of the nail) and also onychomycoses and skin lesions when the same fungus was introduced intracardially (156).

Hyperkeratotic lesions of the soles with long disquamation (45 days) without any inflamatory manifestations and also lesions on the skin of the body of deep trichophytosis type were induced when rubbing the cultures of *E. rubrum* in scarified skin (185). A new method of inducing experimental dermatomycoses by means of rubbing into scarified skin agar treated dermatophytes has been described (97).

Experiments on rabbits on which the hair was removed experimentally demonstrated the pathogenic significance of changes in the thermo-regulating reflex as one of the most important functional mechanisms connecting the organism with the environment (147).

Some of the works outline the current tasks and perspectives of clinical and laboratory investigations of the pathogenesis and therapy of fungous diseases (7, 11, 89).

6. Laboratory diagnostics.

The questions of laboratory diagnostics are dealt with in communications bearing on the luminescent method of detecting microsporotic patients and animals and on the luminescence of certain dermatophytes in cultures as well as in pathological material (166). A study has been made of the practical significance of the luminescent method in dermatology (150), for detecting microsporotic patients (73), for detecting weak forms of lesions as potential sources of microsporosis (127).

A simple method has been described of enriching the microscopic diagnostics of dermatomycosis by the creation of the maceration and the application of adhesive plaster (77).

The modified method of preliminary processing of skin and nail scales during several hours with the 20 % caustic alkali for cleansing the material and, hence, for an easier detection of the fungi has been described (98).

In addition to the already known methods special processing of pathological material with 10 % water or alcohol solution of sodium sulfide during 2—10 minutes without heating has been recommended. This method makes it possible to comparatively quickly detect the fungi without destroying the structure of the hair and the skin scales (105). The works in question describe conditions of cultivating fungi from pathological material in a hanging drop above the test glass with a niche (193), and also the method of obtaining unicellular cultures on compact media (210). The favourable effect of antibiotics when added to agar media has been demonstrated for the preservation of growing cultures of dermatophytes from bacterial contamination (57).

On the basis of studying antigenic properties of 10 different dermatophytes: Achorions — 2, microsporum — 2, trichophytons — 6 — at first with the blood of previously immunised rabbits and then with the blood of 200 patients suffering from different mycoses and 36 healthy persons it has been possible to reveal the difference in the activity of antigenes of different origin and establish that the compliment fixation test with fungous antigenes is a very useful additional method in laboratory diagnostics, especially in those cases when obtaining cultures is difficult (103).

The current tasks of scientific and practical work for the diagnosis of funguos diseases have been outlined (90, 171).

7. The clinical picture of dermatomycoses.

A great number of investigations are devoted to the questions of clinical manifestations of dermatomycoses. These works bear on the history and development of Russian mycology, characterise the practical experience of Soviet mycologists in the field of clinical and experimental investigations of this group of diseases (8), and clinical classification of the fungous diseases of the skin with regard to the character of response reactions of macro-organisms (14).

A number of works are dedicated to the clinical peculiarities of tinea tonsurans, microsporosis, acute and chronic trichophytosis, diseases caused by *E. rubrum* and very rare causative organisms of animal favus like *A. violaceum*, *A. gypseum*, *A. quickeanum.*

Investigations on favus describe clinical manifestations of the disease on the smooth skin and also various methods of therapy and its efficiency. The higher incidence of lesions is noted in winter months when the most common localisation of the foci occurs on the skin of the lower extremities (61, 100, 200).

Clinical forms of favus of the hairy part of the head have been described as well as the character of changes in the hair, their size, forms and dislocation in the follicles and scales, and also the changes undergone by them in the course of the disease and treatment.

To attain a lasting medical effect it is necessary to eliminate all clinical manifestations of the disease, completely remove damaged hairs and to have no deep infiltration of the skin (99).

It has been demonstrated on numerous children suffering from favus that the neck lymph nodes were increased and connected with each other with soft tissue the size of a small green pea up to a size of a walnut. The increase in the size of lymph nodes is associated with the toxines of the fungus which caused the disease (65).

Clinical characteristics of favus-like onychomycoses (202), have been given and a certain similarity has been found between this group of diseases and the group of epidermophytic origin (62). Description has been given of the scutular lesions of the skin, eyebrows and face on the border of the hairline. The patient was a two-week old girl whose mother suffered from the same condition but on the hairy part of the head. The author stresses a special sensitivity of children to favus starting from the first days of their life (54).

The methods of clinical and laboratory investigations demonstrated the possibility of haematogen spreading of favus among animals and men when there are 20 % of fungi in cases of secondary eruptions (multiple, symmetrical and synchronous). This confirms the haematogen-infectious nature of favides (6).

Works on microsporosis bear on the clinical peculiarities of diseases caused by *M. ferrugineum* and *M. lanosum* (107, 134, 192, 204). Regular lesions (65 %) of the scalp have been demonstrated (37, 195). Differences and similarities have been described between microsporic and trichophytic eruptions; regular lesions of the scalp were noted to be more often of the endothrix type than of the ectothrix one. Evaluation of various means and methods of therapy has been given. Especially good results have been pointed out in cases of microsporic lesions treatment on the hairy and smooth skin by means of applying to the lesioned parts of a special adhesive plaster, which gave complete occlusion of the places of lesion (15).

A comparitive study of smooth skin mycosis carried out with extensive clinical material (76) enabled us to establish the fact that such lesions are observed in children as often as in adults in cases of microsporosis caused by *M. lanosum*. Faviforme fungi are characterised by larger foci of lesions and a well pronounced inclination for overall spreading. It has been shown that the scalp is involved in all types of dermatomycoses, however, more often in cases of microsporosis caused by *M. lanosum* (76, 109).

Special investigations are devoted to the clinical peculiarities of the etiology, epidemiology and therapy of fungous diseases in the region of moustache and the beard (25), and also of the diseases of eyelashes and eyelids (181). Different methods of treating the above diseases have been evaluated.

In the works on chronic trichophytosis the clinical picture of the disease in children and adults has been described (41, 56, 178). Special note has been made of the pathogenetic significance of physical underdevelopment and hypogenitalism in some patients (177).

Histopathological investigations of the skin done during the course of the disease revealed degenerative alterations of the epidermis and the hair follicles (38, 41).

An increase in the reactivity of the skin has been noted in response to the administration of allergenic drugs under the action of penicilline-therapy trichophytin and epidermophytin in patients suffering from chronic superficial dermatomycoses. (24).

A number of papers (19, 80, 108, 183, 184) are dedicated to the diseases caused by *E. rubrum*, their clinilal peculiarity and differential diagnosis and therapy.

Descriptions are given of frequent lesions of nails (19) and also of the character of lesions affecting the scalp (108); stress is laid on the individual approach to every case. Means and ways of treating these diseases are outlined (184).

Clinical peculiarities and mycological data on cases of dermatomycoses caused by faviforme tricophytons (32) *A. violaceum* and *A. gypseum* (26), *A. quinckeanum* (194), have been described together with the epidemiological data on a number of diseases.

In describing a very rare condition called tricophytic granuloma caused by *T. crateriforme*, characteristics are given of the clinical manifestations of the disease, of his histological picture and effective methods of therapy are recommended (82).

In the work relating to deep-seated forms of mycoses rare lesions of lymphatic nodes are described as caused by *A. Schönleinii* and also the bone-joint lesions of the phalanges caused by *T. crateriforme* and the lesions of the central nervous system caused both by *T. violaceum* and *A. Schönleinii* (10).

8. The treatment of dermatomycoses.

Quite a number of communications touch on various aspects of therapy of dermatomycoses. They characterize the modern state of affairs in the treatment of trichophytosis, mycrosporosis and favus (12). Ideas are expressed to the effect that irradiation with roentgen rays besides removing the hair, leads to changes in the functional state of the nervous system and also eliminates fungi as a result of the immuno-biological reconstruction of the organism, thus providing for the roentgeno-therapeutic effect of irradiation (13). Opposite ideas are also expressed in the works under review (148). The same works deal with numerous aspects of the practical X-ray epilation: the methods and technique of irradiation (48, 124), the rational condition of children (209), etc. A number of works touches on the efficacy of the piecemeal X-ray epilation, on its advantages and safeness for the children of early age (1.5—3 years), for TB-patients, for meningitis patients (112). The piecemeal method is recommended when it is necessary to take repeated courses of X-ray epilation as called for by mycotic relapses of re-infection (74, 112, 172, 189). Ways are demonstrated of using X-ray epilation for patients suffering simultaneously from mycoses of the hair of the head and patchy baldness (75).

Some of the works under review discuss failures, complications and relapses of X-ray epilation. In them a comparitive evaluation of the efficacy of various methods of irradiation (1-, 4-, 5-field irradiation) and subsequent treatment is made (23, 34, 129); remote results of therapy administrated to adults suffering from chronic trichophytosis is discussed (50).

Modifications of treatment are described to be used after the X-ray epilation in cases of fungous diseases with indications made to their positive aspects as well as shortcomings (145, 160).

Amongst the communications on the therapy of dermatomycoses (without resorting to X-rays), a number of them bear on the efficacy of using thallium plaster, on the evaluation of the efficacy of different concentrations of the latter and methods of withdrawing it from the organism (22, 30, 140, 161).

Oxalic acid (85) was studied as a method of therapy without the application of roentgen rays. The regimen and efficiency of iodine therapy (128), the medicamentous forms and the method of using formalin (104), benzaldehyde in deep-seated cases of trichophytosis and microsporosis (81) were discussed together with the application of ethylmercurphosphate (40), monoethylic ether, ethylenglycol (33), and various synthetic preparations structurally close to syntomycin (29). A method of oxygen therapy administered to calves suffering from trichophytosis was described (139) and mention has been made of applying Lesov's liquid (138) and also of the application of diathermal coagulation of the hair follicles attacked by fungi (117). Some of the works evaluate the "method of aggravation" of inflammatory reactions in places of lesions by the application of an ointment consisting of salicylic (4.0), lactic or benzoic (2.0) acids in vaseline (24.0) which is done under wax paper for 48—72 hours (180, 182). The method of therapy and prophylaxis of superficial dermatomycosis in conditions of Sochi-Matsesta health resort has been described (4).

As an addition to the generally accepted methods of therapy some of the papers mention the manufacturing and application of fungous vaccines from pathological materials, (hair infected by *M. lanosum*, scutula) for the treatment of various dermatomycoses by means of intracutaneous injections (28).

Results of the application of novocaine blockade for the treatment of chronic trichophytosis in adults have been described (164).

Some of the communications touch on the comparitive evaluation of the efficiency of treatment of onychomycoses in clinical and ambulatory conditions (1, 176), on the modification of known (142) and description of new methods of therapy of the fungous diseases of the nails (52). Current tasks facing investigators in the field of therapy of dermatomycoses have been outlined (7, 16, 90).

9. Epidemiology and prophylaxis of dermatomycoses.

Many works touch on the questions of epidemiology, organization of control and prophylaxis of dermatomycoses.

The main factors have been studied in the spreading of fungous diseases, the manner in which they are transmitted at schools and boarding-schools, in the family, etc. (51, 92, 200). It has been found that chronic forms of trichophytosis in adults play a very important role in the spreading of this disease (31, 58, 94). Stress has been laid on the significance of timely detection of fungous diseases and on the danger of partial anti-epidemic processing of the place of infection, as leading to the new forms of the disease. (39) New efficient norms have been evolved for the control of dermatomycoses (5).

Interesting epidemiological data have been received bearing on the role of domestic and field mice in the spreading of superficial and deep-seated forms of trichophytoses caused by *T. gypseum*. Epidemiological peculiarities of attacks, clinical forms of diseases in men and rodents have been described. The necessary prophylactic measures have been discussed(18, 27, 151).

Considerable epidemiological role of cats in the spreading of microsporosis caused by *M. lanosum* has been described. The clinical forms of lesions in cats have been studied and significance of uncommon and trite forms for the spreading of microsporosis in man and animals has been demonstrated (43, 115, 167, 168).

A study has been made of the epidemiological specificity of diseases caused by *M. ferrugineum* (21, 172) and the role of barbers' shops in the spreading of dermatomycoses has been shown (37).

The experience of dermatomycosis control in rural localities has been summed up in some of the works (42, 111, 132, 133, 136). The same works stress the necessity of systematic prophylactic examinations of the population (114) and describe the methods of decreasing morbidity rate, sanitation of districts and mass sanitation of the population as regards dermatomycoses (113, 123, 208).

On the basis of extensive experience it has been demonstrated that planned combined methods in the control of dermatomycoses have a very great significance for conquering this group of diseases. Various methods of treatment have been evaluated and an analyses of causes of recidives has been given. Special mention has been made of sanitary-prophylactic measures (101, 122, 175).

The questions of sanitary-mycological examinations of public baths (153) and their equipment have been raised together with the burning issues of the organization of disinfection measures in regard to fungous diseases in rural localities (39).

A number of works bears on the evaluation of the prophylactic significance of gelatine and glue caps (bandages), the methods of their preparation and application. Certain side effects from the application of these caps have been described (78, 110, 116, 122, 154, 162). Some of the works under review touch on prophylactic measures, health education and current tasks in the prophylaxis of dermatomycoses in urban and rural localities (16, 17, 79, 89, 94, 125).

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II. EPIDERMOMYCOSES

Epidermomycoses, epidermophytosis, pithyriasis versicolor and nodular trichosporosis.

The species content of epidermophyta differs somewhat in various regions of the country.

E. KAUFMANN-WOLF occupies a prevalent place whereas *E. niveum* and *E. rubrum* are not so frequent, the latter having a tendency towards wider spreading. *E. inguinale* and *E. gypseum* are rare (26). Works under review touch on the questions of the variability of epidermophyta (22) and also on similarities and differences of *E. rubrum* and *E.* KAUFMANN-WOLF (29).

In the study of pathogenesis of epidermophytic diseases it has been shown what significance traumatic lesions of peripheral nerves have; stress has been laid on the correlation between alterations in the nervous system and activity of epidermophyta (7). Some views have been expressed on epidermophytoses that it is a secondary and not an independent condition appearing against the background of dyshidrosis (10.)

Some of the works describe different courses of epidermophytoses depending on different climatic conditions. Thus, it has been demonstrated that epidermophytosis takes a graver course in cases of the immunological inertness of patients when there is lack of vitamins in the organism (14).

As a result of studying epidermophytic skin samples in cases of epidermophytoses it has been demonstrated that the application of these samples for differential diagnosis of dermatoses identical with epidermophytoses is very profitable (4, 6).

The diagnostic value of allergic tests is somewhat decreased by negative reactions (21.7 %) in patients suffering from intertriginous forms of epidermophytosis when there is a fungus in the pathological material (6). The nervous apparatus of the skin has also been studied in cases of epidermophytoses (17). A number of works notes the clinical diversity of epidermophytoses and the presence of weak forms of the disease (38). The same works reveal the etiological heterogeneity of lesions of the feet caused by dermatophytes, thread-like, yeast and yeast-like fungi. Points of difference have been mentioned between epidermophytic and yeast lesions of the feet which facilitate the etiological diagnosis even before laboratory investigations (27, 30).

Certain views have been expressed as to the nature of mosaic fungi in cases of epidermophytosis (4, 26).

Differential features of various lesions of the feet have been evaluated and chronic trichophytosis of the soles and palms has been described. Special mention has been made of the similarity of the lesions of the soles caused by various *Candida* with the epidermophytic ones. It has been frequently mentioned that in the differential diagnosis of lesions of the soles it is necessary to closely observe the anamnestic data of the patient such as age, clinical peculiarities of the disease, results of laboratory investigations and also epidermophytic tests (4).

Various aspects of therapy of epidermophytosis have been mentioned by a number of authors (1, 9, 21, 33). Favourable results (weakening or disappearance of itching, etc.) have been obtained by injecting 0.25—0.5 % novocaine solution simultaneously with treating patients with antiparasitic drugs (28). In regular clinical observations of patients suffering from acute dyshidratic and squamous forms of epidermophytoses favourable results have been achieved by the administration of warm baths (30° C), baths with the addition of 1 % solution of mustard or wet bandages soaked in 0.5 % solutions of mustard (16).

A study has been made of X-ray therapy (15), application of oxalic acid solution (35) in cases of epidermophytoses of the soles and sometimes the spraying of the soles with chlorethyl (14) has been practised.

A number of communications present the experience of epidermophytosis prophylaxis and control in various conditions of life and work and in various geographic localities (13, 20, 24, 25, 30, 32, 36). Stages of epidermophytoses control have been described such as detection of cases, disinfection and treatment measures, etc. The favourable effect of the prophylactic application of 1 % iodine tincture to the soles has been noted (37).

The regimen of work and rules of operation of floorlevel washstands for washing feet with warm water in bathhouses, swimming pools and shower sections has been described (23).

Further tasks in the control of epidermophytoses based on dispensary principles (18) have been outlined. The necessity of using poly- and mono-allergic drugs for specific desensibilization and selection of cultures for the vaccine therapy of epidermophytic diseases has been laid stress upon. Clinical manifestations of the appearance of pityriasis versicolor on the hairy part of the head have been described together with the detection of the fungus, the means and methods of its therapy (3, 11).

The works bearing on nodular trichosporosis present clinical, mycological and epidemiological data and indicate the methods of treatment (2, 5, 8, 34). The works in question reveal peculiarities in the manifestations of erythrasma (folds between fingers, softness of fingers, toes etc.). and point to the aggravation of clinical manifestations if the sweat secretion in the patient is excessive (12)

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III. MONILIASES (CANDIDOSES) AND YEAST-MYCOSES

Moniliases (Candidoses).

A new species content of yeast-like fungi in diseases caused by *Candida* has been studied and also in cases of dermatomycosis of the skin and the scalp, etc. (5, 8). A study has been made of the microflora of the skin of bakery workers (9), genitalia of women suffering from gonorrhea (19), of the intestine in cases of chronic diarrhoea (31), etc. It has been noted that yeast-like fungi have definite pathogenetic significance in corresponding cases.

On the basis of a comparative study of the history of various representative of yeast-like fungi of the genus *Candida*, it has been possible to draw up their morphological characteristics, show their similarities and diffrences and describe four main types in the development of batrytio type fructification (6). Some of the communications under review present materials bearing on the adaptive variability of unicellular cultures of yeast-like fungi of the genus *Candida* to the effect of antibiotics (34, 93), on the media consisting of the human tissues such as brain, liver, kidney, spleen, lungs (46), under a short-term action of various (32) chemical drugs in substrates (37) rich with and deprived of proteins. Changes have been noted in the cultural peculiarities and also in the transition from smooth forms into rough ones, changes in the types of growth, carbolytic activity and pathogenity.

Changes in the antigenic properties of saprophytic yeast *Saccharomyces*, *Mycoderma*, *Torulopsis* and pathogenic yeast-like fungi of the genus *Candida* have been studied by inoculativity the material in rabbits.

The results showed that strains adapted to rabbits had a greater immunogenity than the initial ones not passaged on rabbits.

The immunogenic activity of adapted cultures of *Candida albicans* proved weaker than in the same strains of *Mycoderma*, which have a more pronounced immunogenity (48).

The suitability of various inorganic and organic sources of nitrogen nutrition (25) has been evaluated, together with the same data on various carbohydrates, aliphatic and aromatic compounds (26) and microelements (27). Synthetic medium has been selected for a study of metabolism in yeast-like fungi (25). The stimulating effect of antibiotics on the development of yeast-like fungi of the genus *Candida* in the cultures and organisms of experimentally infected animals has been demonstrated (28, 29).

A comparative study of various chemicals (31) used in experiments in different concentrations and throughout different periods of action in the form of water solutions and 50 % sera demonstrated that iodine preparations, carbolic acid, manganese oxide, formalin, chloramin, resorcinal and formic acid are the most active agents against *Candida* (38).

Special experiments staged for a comparative study of the pathogenity of yeast-like fungi of the genus *Candida* recovered from patients and also from the environment revealed a notable effect of the conditions of development on the pathogenetic properties of yeast-like fungi. An increase in pathogenity has been noted during passages on rabbits whereas passaging on vegetable media was accompanied by a weakening of pathogenic properties (45).

In the process of adaption of *Candida albicans* on media with different organs of man it has been noted that certain physiological properties and pathogenity undergo certain changes which have been especially well pronounced in cultures repeatedly seeded in the spleen media (47).

On the basis of a comparative study of various indices of the pathogenity of yeast-like fungi of the genus *Candida* it has been noted that checking on the hialuronidase activity and intracutaneous infection of rabbits has been complete. At the same time it has been demonstrated that the agglutination reaction with specific sera may serve as an auxiliary method for the determination of yeast-like fungi (67).

A comparative study of antigens prepared from yeast-like fungi by different methods made it possible to establish the fact that alcohol antigens are the most specific (43).

It has also been demonstrated that the repeated stimulation of the organism with antigens from yeast-like fungi is accompanied by an increase of specific and non-specific reactions, by a higher leucocytosis, changes in the erythrocyte sedimentation reaction, changes of temperature and weight — all factors which are considered by the authors in the light of general physiological laws of stimulation and inhibition (50).

In the process of a comparitive study of different methods of immunization for the production of active sera against yeast-like *Saccharomyces*, *Mycoderma*, *Willia*, *Torula utilis* and yeast-like fungi of the genus *Candida* the most favourable results have been received after a long immunization (1—2 years) first with the killed and then live cultures of experimental strains.

The antigenic activity varied in different cultures when immunized with yeast-like fungi of the genus *Candida* and the lowest sera titers were obtained in this case: *Torulopsis* and *Mycoderma* proved the most antigenic (53).

In special experiments on infecting rabbits with tagged radioactive isotopes of the cultures *Candida albicans*, different modes of spreading, different period of stay of *Candida* in the organism of immunized and non-immunized animals have been demonstrated. It has also been shown that yeast-like fungi tagged with isotopes deserve attention when dealing with the elaboration of various aspects of the pathogenesis of diseases caused by *Candida* or when predicting the fate of fungi in the organism when various methods of treatment are applied and there are different immunogenic states of the organism (41).

A number of works are devoted to the clinico-epidemiological peculiarity of diseases caused by *Candida*, while some of them bear on the role of yeast-like fungi in cases of eczema (57). Some of the papers stress the significance of the lesions of the superficial skin (24, 64, 73) and big folds of the skin in the pathogenesis of the clinical course of internal diseases of man (60).

Lesions of the central nervous system caused by *Candida* (44) have been described together with the description of widely spread dermatoses with lesions of the scalp (22), atypical genital lesions (20), deep granulomatouse forms (42) of lesions of the mucous membrane in cases of leucosis (66) and also uncommon lesions of the ear (13).

Histopathological picture has been given of paronychia, interdigital erosions and eczemoid lesions caused by yeast-like fungi (76).

A number of works presents observations on the *Candida* infection complications after irrational antibiotic therapy, on their clinical peculiarities, pathogenic factors and methods of treatment (1, 3, 35, 36, 39, 48, 2). Superficial diseases in children (4, 21, 35) have been described together with their course, and outcome. Non-generalized forms of diseases in children and adults (15, 17, 30, 35, 52, 62, 70) have been described also and certain issues of the treatment of *Candida* diseases have been discussed (59, 69, 74).

The questions of laboratory diagnosis are given special space in works bearing on the application of antibiotics for making pure cultures of yeasts and yeast-like fungi (7), on the methods of isolating pure cultures (58) and on the diagnostic significance of the complement fixation test in cases of yeast diseases. It turned out that the complement fixation test yields positive results in cases of chronic and widely spread mycoses. The complement fixation test is also observed in acute and organic processes. It has been pointed out that by using the method of the complement fixation test one can obtain data on the antigenic affinity of various species of yeast-like fungi (54).

Some of the works are devoted to the study of the incidence (18) and carrying period of yeast-like fungi of the genus *Candida* in man and experimentally infected animals. Long carrying of yeast-like fungi (12 months) has been demonstrated in the foci of previous attacks among the recovered patients after paronychia and interdigital erosion. As a result of a special ezamination of rabbits infected intracutaneously or subcutaneously (*Saccharomyces* sp., *Mycoderma* sp., *Cryptococcus* sp.), with various types of *Candida* fungi it has been demonstrated that these fungi could be detected in the brain, heart, lungs, kidneys, liver and spleen in obviously healthy animals killed at different times. The most frequently to be detected were yeast-like fungi and especially *Candida albicans.* Real yeasts (*Saccharomyces* sp., *Mycoderma* sp.) have been by far not so often found. Special stress is laid on the pathogenetic and epidemiological significance of a long-term carrying of fungi in the organism of animals without any obvious changes in the internal organs (49).

Traumas and macerations have paramount significance, in the pathogenesis of superficial *Candida* diseases. It has been shown that there is a possibility of direct and indirect transmission of pathogenic fungi from an ill person to a healthy one (72, 75).

Current tasks in the field of diseases caused by *Candida* have been outlined for the near future (32).

Epizootic lymphangitis (Cryptococcos of horses).

The question of mycology of epizootic lymphangitis have been raised in a number of investigations. Results of the study of etiology, clinical picture and epizootology of this disease and also of the acute form of lesions in mules (12) have been described. Indiced lymphangitis in animals has also been discussed, animals being infected with *Cryptococcus neoformans* (51). Pathologo-anatomical data in cases of this condition among horses were described (56). Mention has been made of an early diagnosis of lymphangitis and the significance of allergy (11, 65).

Observations are quoted bearing on the therapy of epizootic lymphangitis, the efficiency of carbolized solution of potassium iodine (65), ichthyol (14, 52) hyposulphite (61), penicillin (68), etc.

A number of works is devoted to various questions of epizootology of horse lymphangitis, the seasons of infection (16, 55) and also measures for eradication and prophylaxis of the disease (10, 67, 71).

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IV. ACTINOMYCOSES, CHROMOMYCOSIS AND OTHER MYCOSES

This section includes works devoted to actinomycosis, micromonosporosis, chromomycosis, mildew mycosis, laryngomycoses and other questions of medical mycology.

In communications on actinomycosis questions are raised bearive on the spread of this disease (51), on peculiarities of its causating organism (56), on the significance of actinomycetic lysis in the pathogenesis and therapy of actinomycosis (22), on the peculiarities of forming crystalline druses in the cultures of white blood corpuscles with actinomycetes (26, 27).

A number of works touches on the diagnosis of actinomycotic diseases (2), evaluation of microscopic investigations (21), serological reactions (10), skin allergic tests with actinolysate (9), and X-ray investigations (47).

Certain aspects of the pathogenesis and therapy of actinomycotic diseases have been touched upon (13, 44).

Main types of skin lesions and their combinations have been described (23, 44) as well as peculiarities of primary actinomycosis of the skin, generalized as well as localized, actinomycotic lesions of the facial-maxillary region (30, 42), actinomycotic osteomyelites (48), and late complications of gunshot wounds (25). The role of actinomycetes has been noted in the etiology of purulent lung infections (53).

Lesions of the tongue (38, 39), gastrointestinal tract (12, 31), ear (41), orbit (16), heart (19), spinal cord (51) and other rare atypical forms (8, 29), have also been described.

A number of works touches on the combined therapy of actinomycosis (40, 46, 52), on the use of penicillin (1, 17, 20, 43, 54), treatment with penicillin and red blood mass transfusion (35) and Phtivasid (14). Some of the works deal with the questions of immunotherapy of actinomycoses (7, 50).

Clinical manifestations, histopathological data, causative organisms, diagnosis, and therapy of micromonosporosis (4, 24) have been described.

Clinical, histopathological and mycological characteristics of patients suffering from chromomycoses have been given. Note has been made of the efficiency of therapy. Indications have been given of the favourable results of the chronic treatment of one patient with vitamin D_2 (6).

Clinical peculiarities, mycological and experimental data on Aspergillus lesions of bronchi and nails have been described as well as intoxication of bronchomycosis and similarity of mildew onychomycosis with epidermophytic ones (34, 37).

Description has been made of clinical peculiarities and experimental data as regards etiology and pathogenesis of pharyngomycosis, doubts have been expressed as to the etiological role of *Leptothrix*, the significance of *Candida* in association with other microorganisms (3) has been noted, certain questions dealing with pharyngomycosis have been raised (3, 11, 33).

Mycological characteristics of the yeast-like fungus of the genus *Trichosporon* has been given, its morphological peculiarities, carbolytic activity, hemolytic and antigenic properties studied, etc. Optimal conditions for the growth of this fungus has been determined and it has been found that *Trichosporon* is frequently detected in cases of epidermorphytosis of the feet and conditions similar to it (32).

A new pathogenic fungus from the genus *Fusarium* isolated from chronic relapsing ulcerative lesions of the skin has been described. Certain considerations of its pathogenity for the patient have been presented (28).

On the basis of clinico-mycological and epidemiological peculiarity and for the benefit of control and prophylaxis it is recommended to differentiate diseases caused by large-spore faviforme dermatophytes from the group of trichophytic diseases (18).

In the works under review data on the historical development of Soviet mycology have been quoted (5, 55).

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V. Monographs and guides

1. Adreasyan G. K. Fungus Diseases of the Nails. Medical Literature Publishing House. Moscow 1951, Pp. 120, with 90 illustrations.

The monograph presents main data in the field of the clinical picture, differential clinical and laboratory diagnosis, epidemilogy and treatment of the fungous diseases of the nails. Histopathological observations of the author are described. Detailed explanation is given of the author's method of treating onychomycosis.

2. Aravissky A. Variability of the Causative Organism and Clinical Polymorphism of Favus. The Novosibirsk State Publishing House. Novosibirsk, 1949, PP. 272, with 63 drawings.

The monograph quotes all necessary literature bearing on the causative organism of favus, its polymorphism and variability. Detailed analysis of factors providing for the pathogenesis and clinical peculiarity of favus is made. Thorough study is made of the works bearing on atypical forms of favus which make it look like other diseases, namely, trichophytoses. Wide clinical observations of the author are described. Among them should be mentioned the following original observations: uncommon forms of favus, "forms of transmission" from typical favus to typical trichophytoses, favic meningoencephalitis, associated forms of favus, tuberculosis or syphilis, peculiarities of visceral forms of favus, etc. The work describes various stable hereditary uncommon cultures of *A. Schönleinii* recovered from patients. Description is also made of the experimental data on the influence of C-avitominosis on the appearance of favus of internal organs of laboratory animals.

3. Arievich, A. M. Superficial Yeast-Induced Lesions of the skin and Mucous Membrane. Medical Literature Publishing House, Moscow 1949, pp. 246, with 16 drawings.

The monograph presents all necessary literature data and wide observations of the author as regards the clinical cause and differential diagnosis of superficial yeast-induced lesions of the skin and mucous membrane, pathogenetic and epidemiological peculiarities of these lesions, laboratory diagnosis and therapy. Numerous issues of the prophylaxis of superficial yeast-induced dermatosis are being dealt with. The author suggests the clinical classification of superficial yeast-induced dermatosis.

4. Arievich, A. M. & Stepanishcheva, Z. G. Atlas of Fungous Diseases of the Skin. Medical Literature Publishing House. Moscow 1951. Pp. 251, with 553 drawings.

The atlas demonstrates various aspects of the clinical picture, diagnosis and mycology of fungous lesions of the skin and its appendages and at the same time provides the main information in the field of epidemiology and treatment of dermatomycosis.

5. Asnin, D. I. Immunodiagnosis of Actinomycosis-Medical Literature Publishing House, Moscow 1956. Pp. 90, with 36 drawings.

Clinical and diagnostic observations of the author are briefly outlined here and literature on immunodiagnosis of actinomycosis is quoted. The author describes the method of skin allergic tests and complement fixation tests with actinolysate. The specificity of these tests is demonstrated together with their diagnostic significance in a combined diagnostic investigation of actinomycotic patients.

6. Astvatsaturov, K. R. Laboratory Diagnosis of Skin and Venereal Diseases. Medical Literature Publishing House. Second revised edition. Moscow 1950, pp.

The works makes a brief outline of the main methods of laboratory diagnosis of fungous diseases necessary in everyday practice of dermatologists and microbiologists.

7. Berdigan, K. I. Actinomycosis of the Face, Jaw and Neck and the Modern Methods of Treatment. State Publishing House of the Byelorussian S.S.R. Minsk 1955, pp. 129, with 7 drawings, 7 tables.

The monograph is devoted to the clinical characteristic of the author's extensive observations bearing on the diagnosis and therapy of actinomycosis of the cervical, facial-maxillary and temporal regions.

A characteristic is given of the spreading of actinomycotic process and prophylactic measures are indicated.

8. BORZOV, M. V. Elements of Dermatology. Moldavian State Publishing House, Kishinev 1950, pp. 208, with 48 illustrations.

The main information is quoted on the causative organism, clinical picture, laboratory diagnostics, therapy and epidemiology of superficial and deep-seated mycotic lesions.

9. Infectious Diseases of Man. An Academic Manual. Editor: V. M. ZHDANOV. Medical Literature Publishing House, Moscow 1955. Fungous Diseases (Mycoses), pp. 391—476.

The three chapters written by V. M. ZHDANOV, P. M. KASHKIN, I. S. POPOV, and G. O. SUTEYEV present brief data on the causative organisms, clinical manifestations, epidemiological peculiarities, diagnostics and therapy of dermatomycoses, mycoses of the mucous membrane, deep-seated and systemic mycoses including also isolated conditions caused by organisms which are not sufficiently studied and the etiological role of which has not been sufficiently confirmed.

10. KASHKIN, P. N. Dermatomycoses. Etiology, Laboratory Diagnosis and Epidemiology. A guide for physicians. First edition, Medical Literature Publishing House, 1950, pp. 225; second revised edition, Medical Literature Publishing House 1953, pp. 274. The guide is illustrated with 30 drawings and 27 tables. It gives all necessary information on causative organisms, laboratory diagnosis and epidemiology of the most widely spread fungous diseases. Main data are quoted on the pathogenesis, clinical picture and therapy of dermatomycosis and also on the character of fungous diseases of animals and their significance in the spreading of dermatomycoses among men. The book presents material based on the author's investigations for many years in the field of microbiology and epidemiology of fungous diseases. It depicts considerable achievements and original trends of Soviet medical mycology.

11. KRASILNIKOV, N. A. Index of Bacteria and Actinomycetes. Academy of Sciences Publishing House, Moscow 1949, pp. 826.

The index is based on botanical principles with regard to biological peculiarities of microorganisms determined by modern investigations of Russian and foreign authors. The group Actinomycetales is systematized wholly on the basis of the author's experimental materials. The index is illustrated with 285 drawings and 3 tables of coloured drawings. Extensive bibliography is quoted in the book.

12. KUDRYAVTSEV, V. I. System of Yeasts. U.S.S.R. Academy of Sciences Publishing House, Moscow 1954, pp. 422.

On the basis of extensive obsevrations and comparative study new classification of yeast is suggested based on the principle of the unity of organisms and conditions of their existence. Types of species of best known yeasts are strictly divided and described. All systematic groups of yeasts are described against the background of the history of the development of investigations of each of them with references made to original works. To make the description of almost all types of yeasts more demonstrative, original drawings have been provided.

13. MATUSHKIN, E. A. Basic Principles of Modern Theory of Epidermophytosis. Published by the Military Naval Medical Academy, Leningrad 1947, pp. 235.

The monograph gives extensive literary data and rich clinical observations of the author bearing on pathogenesis, clinical course and therapy of epidermophytic infections and allergic forms of lesions. Numerous questions on laboratory diagnosis and epidemiology of epidermophytoses are raised, especially those of morphology and biology of epidermophyta.

14. MEISEL, M. V. Functional Morphology of Yeast Organisms. A monograph. U.S.S.R. Academy of Sciences Publishing House, Moscow, 1950, pp. 368, with 59 drawings.

The monograph summarizes modern knowledge on the structure of the cell in general and yeast and organisms close to yeast in particular. Results of the author's investigations on the functional-morphological reconstruction of cells in conditions of the anaerobic development are presented. Experimental data and theoretical concepts bearing on the significance of vitamins in the forming of the functional-morphological type of cell are summed up together with the same data on the fermentative cellular reconstruction and in the dysfunction of cells as a result of a faulty provision of the latter with vitamins.

15. New Fungous Disease of Horse and Men (Stachibotritoxicosis). Collection of articles edited by DROBOTKO, V. G. Ukrainian Academy of Sciences Publishing House, Kiev, 1949, pp. 115.

16. OKUNEV, I. V. Epizootic Lymphangitis. State Publishing House of Agricultural Literature, Moscow 1953, pp. 231, with 44 drawings.

The monograph deals with the questions of etiology, pathogenesis, pathological anatomy and especially early diagnosis, clinical course and treatment of horses ill with epizootic lymphangitis (*Cryptococcus*). The book presents materials on epizootology of the disease and describes methods in detail of eradicating it.

17. OSPOBAT, B. L. Actinomycosis in a Surgical Clinic. Medical Literature Publishing House, Moscow 1950, pp. 179, illustrated with 115 drawings.

The monograph presents materials on the etiology clinical picture and therapy of actinomycotic diseases, evaluates laboratory investigations in cases of chronic suppurative processes in the lungs and pleura, demonstrates the ways of lesions of the lung tissue with actinomycetes, Observations are quoted on diagnostic and therapeutic application of actinolysate. Modern methods are described of combined therapy with regard to an evaluation of penicillin.

18. SARKISOV, A. K., KAPUSTIN, V. F., KVASHNIN, E. S. & KOROLEVA, V. P. An atlas of Fungi Pathogenic for Agricultural Animals and

Fowl. The State Publishing House of Agricultural Literature, Moscow 1953, pp. 158, illustrated with 249 photographs.

The atlas is a short visual aid on pathogenic fungi causing mycotic diseases of animals.

The book illustrates clinical forms and causative organisms of mycoses, mycotoxicoses, mildew-fungi saprophytes which are encountered in the fodder and pathological material.

19. Suteyev, G. O. Actinomycoses. Medical Literature Publishing House, Moscow 1951, pp. 304.

The monograph presents extensive materials on the clinical course and picture of actinomycoses, describes rare forms of the disease, quotes new data on the variability of actinomycetes, on the lysis in their cultures, on the combination of anaerobic causative organism with aerobic one in cases of actinomycoses, on the transition of "anaerobic parastie into aerobic actinomycete-saprophyte," etc.

The author relates of many years of experience in the field of treatment of actinomycotic diseases and makes a critical approach to the systematizing of the literary data bearing on the variegated forms of actinomycosis difficult to diagnose.

20. Yakobson, P. Z. Fungous Diseases of the Skin. Moscow 1956. Medical Literature Publishing House, pp. 154.

The book makes a brief outline of the main clinical laboratory data regarding fungous diseases of man. The main data given on the epidemiology of dermatomycoses and organization of their control.

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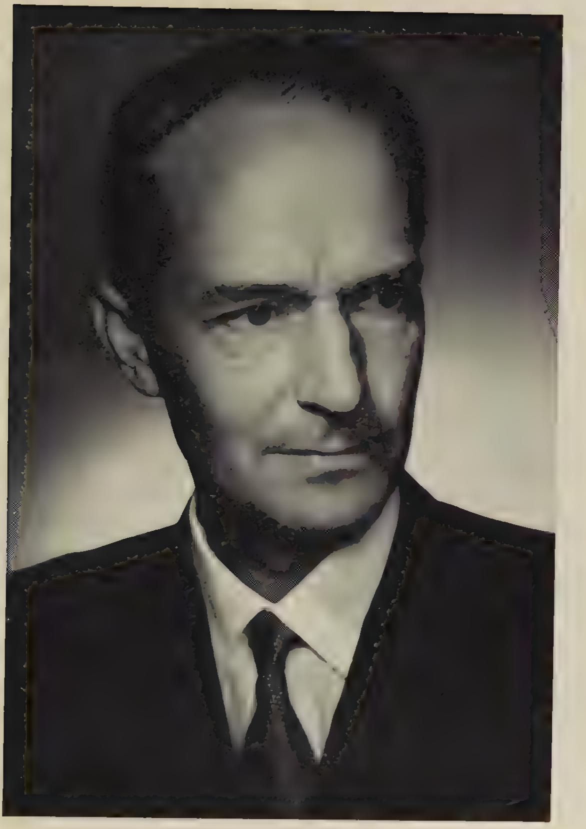

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HOST/PARASITE RELATIONSHIPS IN EXPERIMENTAL MONILIASIS: I. Candida albicans

by

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(31.X.1958)

Introduction

Before testing for the effects of chemotherapeutic agents on laboratory animals experimentally infected with fungal pathogens, it is essential to obtain an accurate assessment of infection degree in control animals. It has been customary to resort to the use of mortality tables and/or pathogenicity ratings (SCHERR, 1953). The latter constitute a standard method of assessment adopted in the field of plant pathology, and usually involve the estimation of infection degree on the basis of gross pathology. In many cases, histological examination of infected tissues is not undertaken.

The following paper offers an interpretation of experimental moniliasis of mice with particular reference to assessments of fungal morphology in relation to host defence reaction.

Experimental

Preliminary experiments embodying the intraperitoneal inoculation of mice of the inbred strains A, CBA and R3 with isolates of *Candida albicans*, indicated that their susceptibility to infection was relatively uniform and independent of sexuality. A comparable susceptibility occurred in mice of an outbred strain.

In order to investigate infection degree based upon mortality, 36 animals of outbred strain were tested against the following isolates of *C. albicans*, the sources of which are indicated.

E_1-vagina, C_2-appendix, C_3-gastric washings, D_2-lungs (postmortem) S_1-sputum.

25 animals were divided into groups of 5, each group being allotted to a different fungal isolate. Inoculum was administered at a blastosporic density of 1,000,0000—1,200,0000 in 0.2 ml. sterile, distilled water.

In order to test the effects of diminishing spore densities, all further animals were so divided that 2 were inoculated with isolate E_1, 2 with isolate C_2, the inoculum being 100,000 blastospores, 3 with E_1 and 4 with C_2, inoculum containing approximately 1000 blastospores.

To augment the above series, 10 animals of strain L mice were divided equally, one group receiving inoculum of E_1, the other of C_2 at a density of 1,000,000—1,200,000 blastospores. Throughout an experimental period of 75 days, after which surviving animals were sacrificed, stock was kept at a temperature of 63° F, and allowed unlimited water and standard rat cake.

Results

1. Factors affecting degree of infection.

The results (Table I) show that at the highest densities of inoculum used, isolate S_1 is not pathogenic; the remainder are equally pathogenic to outbred mice. Isolate E_1 shows reduced pathogenicity towards mice of strain L; isolate C_2 is not pathogenic. The latter fungal isolates, when administered at reduced dosages, become further differentiated, isolate C_2 showing eventual loss of pathogenicity.

TABLE I

Fungal Isolate	Inoculum density	Number of mice inoculated	Strain	Number of deaths due to moniliasis	Range of survival in days	Disease Reactions	
						Acute	Chronic
E_1	-1,000,000 1,200,000	5	Outbred	5	6—9	5	0
C_2	,,	5	,,	5	9—20	4	1
C_3	,,	5	,,	5	9—12	5	0
D_2	,,	5	,,	5	9—19	4	1
S_1	,,	5	,,	0			
E_1	100,000	2	,,	2	6&7	2	0
C_2	,,	2	,,	2	18&29	0	2
E_1	1000	3	,,	1	75	0	1
C_2	,,	4	,,	0			
E_1	1,000,000 -1,2000,00	5	L	2	14&16	0	2
C_2	,,	5	L	0			

It is clear that any estimate of infection degree for purposes of the standardisation of a particular fungal isolate must include consideration of the genotype of the host, the genotype of the pathogen and the density of the inoculum presented to the host. Included in Table I are assessments of host disease reaction which will be discussed in the following sections.

2. Host/parasite relationships.

Clinical symptomatology

Animals experimentally infected with *C. albicans* generally show a progressive lethargy and emaciation terminating in death, with, in some cases, the development of excessive thirst shortly before death. This latter symptom was outstanding in two cases, one from the C_2 and one from the D_2 series, in which the terminal stages of disease also included the development of circular movement. The head was held stiffly to one side, presumably owing to the involvement of the musculature of the neck. The direction of locomotion was confined to the side of the animal to which the head was held. In one of these animals, that inoculated with isolate D_2, intermittent, convulsive rolling movements occurred shortly before death. FUENTES, SCHWARZ & ABOULAFIA (1952) record similar instances in inoculated rabbits and regard sleepiness as the major symptom in mice.

Gross pathology

This was studied exclusively in the thorax and abdomen. Visible evidences of fungal activity are principally of two kinds.

(a) Extensive fungal growth forms, often easily detachable, and composed of pseudomycelium and free blastospores, occur frequently within the abdominal cavity, loosely adherent to the peritoneum. Such growth forms may be referred to as plaques, owing to their flattened, often disc-like shape.

(b) Abscesses encountered in most viscera, indicative of deep-seated infection, are characteristic of moniliasis. The abscesses are creamy white, and generally solitary, but may become confluent and extensive.

Length of survival of the infected animal is positively correlated with the degree of renal involvement. In the present series, all animals dying within twelve days from the date of inoculation showed what is regarded as an acute disease reaction. Macroscopically, this reaction is characterised by the presence of variable numbers of protruding abscesses of the cortices of one or both kidneys, and by the absence of any abnormality of the renal pelvis. The involvement of other viscera is variable and not necessarily of diagnostic value. The heart may or may not have visible, punctiform ventricular abscesses.

In animals surviving beyond twelve days, the above reaction is replaced by a chronic disease reaction. The renal cortex is invariably devoid of abscesses, but the renal pelvis is usually dilated and often yellow in colour owing to fungal colonisation. Abscesses may be found in other organs, but are often entirely absent.

Histopathology

In addition to routine staining with haematoxylin and eosin, three further staining schedules were applied to sections of material which had been fixed in Zenker's fluid, formalin neutral and Bouin's fluid. Gram staining adequately demonstrated the fungal elements which were in a process of active growth and development. Carbol thionin blue, followed by a counterstain either of orange

G in 50 % absolute alcohol/50 % clove oil, or of fast green in 95 % alcohol, gave a more reliable result than Gram's method. KLIGMAN'S modification of the periodic acid-Schiff stain was found to be the best schedule for all fungal elements in host tissue (CONANT et al, 1954).

Acute disease reaction

In section, the cortices of kidneys removed from acutely diseased animals show a profusion of abscesses, variable in size and spherical or lobulate in contour. Few abscesses occur in the medulla, and fungal colonisation of the pelvis is minimal. A diagnosis of pyelonephritis can be applied. (Fig. 1.)

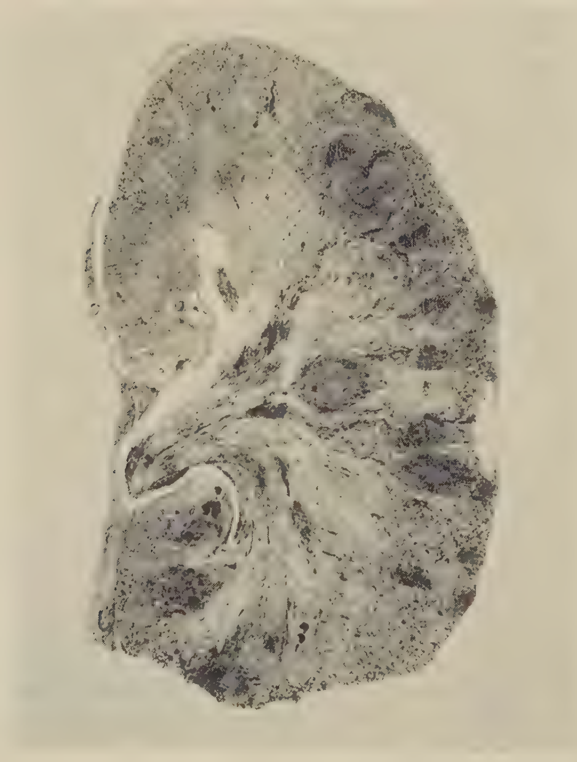

Fig. 1. Longitudinal section of a kidney from a mouse showing the acute disease reaction. Cortical abscesses are numerous. × 5.

A typical cortical abscess consists of a central zone, occasionally incorporating uriniferous tubules not subject to leukocytic infiltration, but colonised by elements of fungal mycelium. Otherwise the zone consists of elements of the fungus intermingled with polymorphonuclears and tubular tissue in varying stages of dis-solution. At the periphery of the abscess there is a broad area of infiltration containing numerous histiocytes, a few lymphocytes and fungal elements.

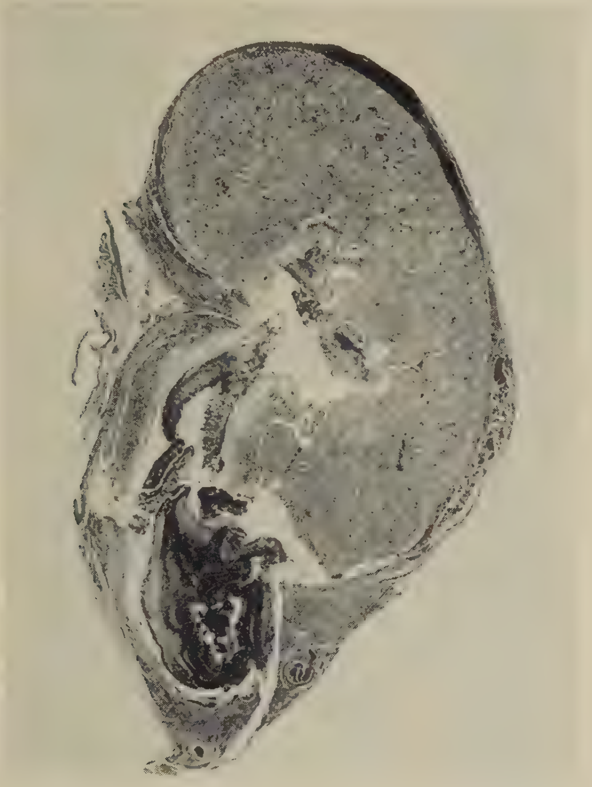

Fig. 2. Longitudinal section of a kidney from a mouse showing the chronic disease reaction. Fungal colonisation of the pelvic cavity and erosion of the medulla are well advanced. × 5.

The morphology and staining characteristics of the fungus vary according to the zonation thus expressed during the inflammatory reaction of the host. In culture, *C. albicans* produces mycelium, largely of pseudomycelial form, and blastospores. Some cultures are predominantly mycelial (M or R forms); others are predominantly blastosporic (Y or S forms). The morphological transformations of mycelium = yeast have been achieved, *in vitro*, by the manipulation of environmental factors by Nickerson & Manowski (1953), and Nickerson, Taber & Falcone (1956).

In the empty lumina of uriniferous tubules, and within the cavity of the urinary pelvis, the emphasis is on cell growth of the fungus as opposed to cell division through budding. The phase which predominates is therefore mycelial, although localised areas of the mycelium undergo division to give short verticils of budding blastospores in 'Mycotoruloides' fashion. (Fig. 4). Using the criteria outlined by WICKERHAM (1951), the majority of the mycelial hyphae may be classified as pseudomycelial, having few septa and distinct constriction. Some hyphae belong to the true mycelial type; others are intermediate in form. The typical pseudomycelium is 2—5 μ wide, and the blastospores derived regionally from it measure 3—4.2 × 4—8 μ. In some medullary areas of the kidney where no inflammatory reaction is evident, pseudomycelium colonising from the urinary pelvis penetrates successive areas of tubular epithelium without morphological change. (Fig. 4).

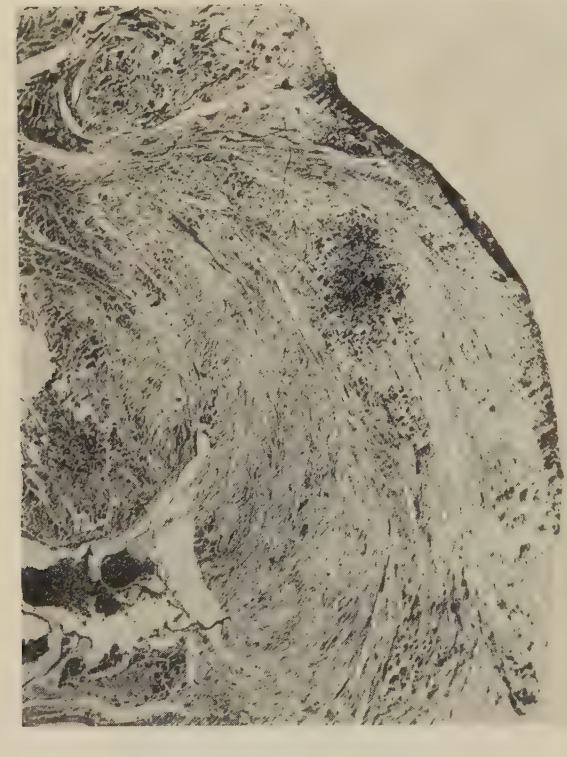

Fig. 3. Abscesses in the myocardium of a mouse showing the acute disease reaction. × 30.

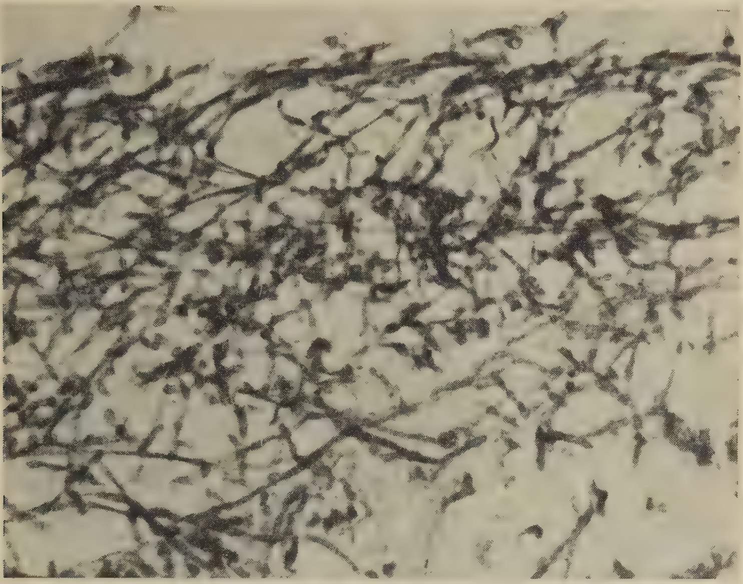

Fig. 4. Basic pseudomycelium of *C. albicans* with localised verticils of blastospores in the cavity of the urinary pelvis. Some fungal elements have penetrated tubular tissue without alteration in morphology. × 600.

The site of origin of a cortical abscess (lesiones de siembra, MACKINNON & RODRIGUEZ-GARCIA, 1935) is usually the glomerulus. Haematogenously disseminated blastospores lodge in the capillaries and germinate by a process of budding. Subsequent cell elongation results in the penetration of Bowman's capsule and colonisation of tubular epithelium by a pseudomycelium of short elements which is deeply constricted. This mycelium is regarded as transitional in form between M and Y developmental phases. It is also subject to marked verticillation. Focal necrosis of host tissue at this stage of parasitism has been described by EVANS & WINNER (1954) in experimental moniliasis of the rabbit.

Fungal colonisation of the lumina of the tubules then follows, and in this site, the typical pseudomycelium with its accompanying blastosporic phase ensues. (Fig. 5). The host response to hyphal invasion is the diapedesis of polymorphs so that a zone of infiltration surrounds the area invaded. Mycelial growth continues to predominate, but is of markedly transitional form, showing increase in width (5—8.8 μ), deep constriction, and a tendency towards reduction in monaxial polar growth by intense development of verticillation. (Figs. 5, 6 & 7). As the abscess ages, necrosis of polymorphs and tubular tissue occurs.

With the onset of necrosis, cell division apparently becomes emphasised within the transitional mycelium, and many of the cells so delimited become dilated ($12—22 \times 12—40\ \mu$), acidophilic in staining reaction, and noticeably refractile in unstained sections. (Fig. 8). Coincidental with this development, which may be likened to the bladder-cell or sclerotial development common to many plant pathogenic fungi (CAMPBELL, 1933), is a phase of mycelial degeneration. Fungal elements become acidophilic and fragmented. (Fig. 7).

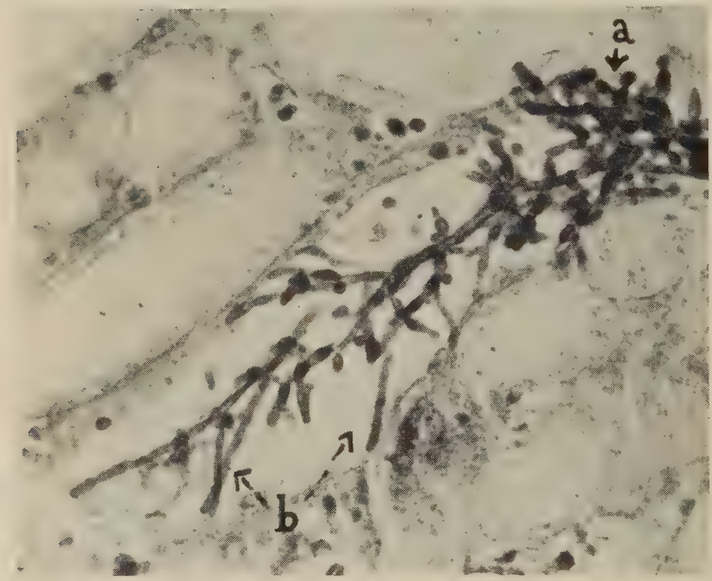

Fig. 5. Transitional mycelium (a) emerging from an area of infiltration by polymorphs and showing a tendency to revert to basic pseudomycelium (b) in the lumen of a conducting tubule. × 600.

The bladder-cell development is maximal within the outer broad fringe of the abscess tenanted by histiocytes and lymphocytes. (Fig. 8). The fungal cells appear to be derived from the distal verticils of the transitional mycelium, and intermingled with them are isolated terminal chains of small actively budding blastospores giving an intense basophilic staining reaction. It would seem that some of these blastosporic chains may also become subject to bladder-cell development.

Cortical and medullary granulomata are frequently encountered in the acute disease reaction. They are composed of tissue infiltrated by concentrically arranged histiocytes, and are bordered by lymphocytes. Small granulomata are often devoid of fungal elements as reported by ADRIANO & SCHWARZ (1955), but those more develop-

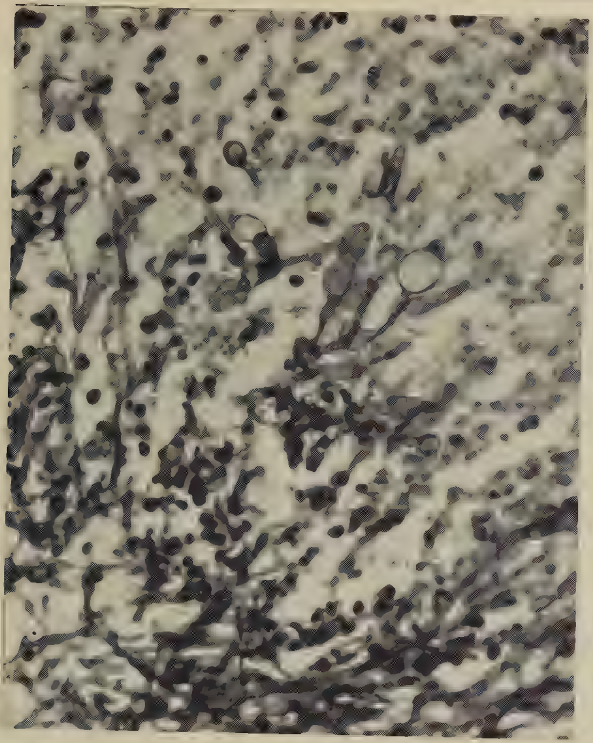

Fig. 6

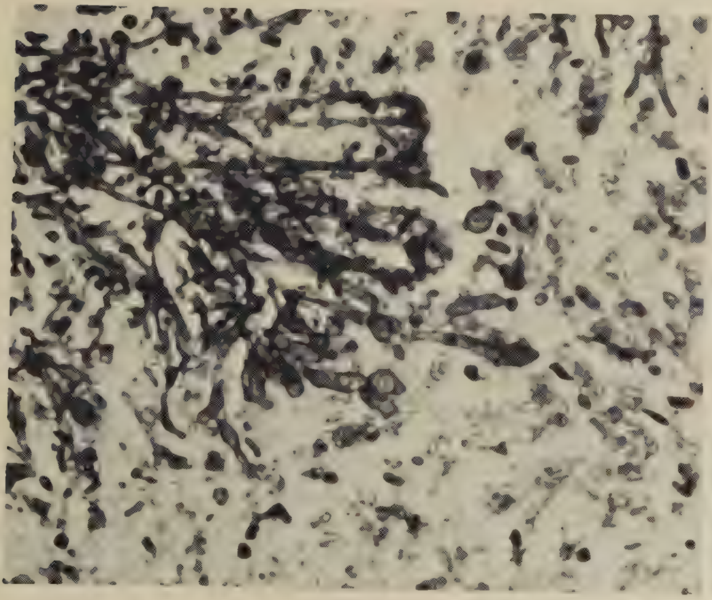

Fig. 7

Figs. 6 & 7. Transitional mycelium in the necrotic centre of a renal cortical abscess. Degenerative elements are intermingled with enlarged bladder-cells × 600.

ed show numerous bladder-cells and short chains of blastospores. The latter rarely show continued activity within a granuloma, but may apparently revert to transitional growth form at the margin of an abscess with resultant lobulation of the lesion.

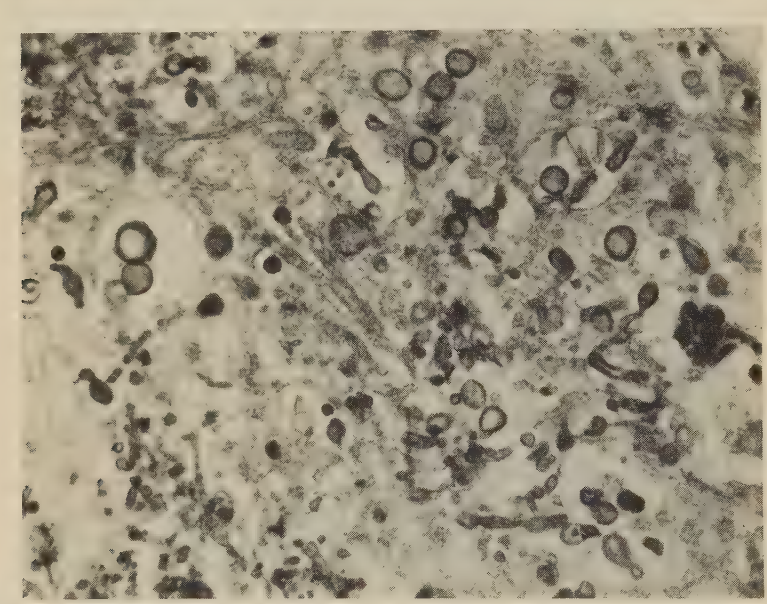

Fig. 8. Fungal bladder-cells and small verticils of blastospores amongst histiocytes and lymphocytes bordering a renal cortical abscess. × 600.

Micro-abscesses, initiated by capillary blastospore germinants are usually plentiful within the myocardium of the heart. (Fig. 3). Sparse accumulations of polymorphs are present towards the centre of the typical abscess, and the fungal elements are of predominantly transitional form. Necrosis of muscle fibres surrounding the abscess is usually well advanced at the time of death. The rapidity and extent of degenerative changes in the myocardium were noted by REDAELLI (1924). Within areas of necrotic muscle fibres and polymorphs, cell division of the transitional mycelium becomes pronounced, and bladder-cells are characteristic towards the fringe of the lesion where blastosporic chains are also frequent.

It seems clear that the cause of death in animals acutely diseased is myocarditis (FUENTES, SCHWARZ & ABOULAFIA, 1952; ADRIANO & SCHWARZ, 1955), and that the progress of disease is dependent upon the haematogenous dissemination of blastospores.

Chronic disease reaction.

Kidney in animals showing this type of disease have distended renal pelves, colonised by a profuse pseudomycelial phase of the fungus accompanied by localised verticils of blastospores. (Fig. 2). Where the pyramidal tissue suffers active erosion or cavitation, however, the mycelium becomes transitional in type. As a result of continued invasion, islands of host tissue are interspersed with foci of infection in which polymorphs occur. Fungal bladder-cell development is common in older foci.

Abscesses and granulomata are generally absent from the renal cortex, but a few infarct-like lesions occur in the medulla (lesiones de eliminacion, MACKINNON & RODRIGUEZ-GARCIA, 1935), where variation in fungal morphology is similar to that described in abscesses of the acutely diseased animal. A diagnosis of pyonephrosis is indicated, and the cause of death in chronic infection is presumably uraemia, as abscesses of the heart are very rare.

Abscesses which are encountered in other organs in both types of disease reaction are basically similar to those found in the kidney cortex. It is noticeable, however, that in the frequently more extensive abscesses of the liver, fragmentation of fungal mycelium in the areas of necrosed polymorphs is well advanced.

An interpretation of fungal morphology in relation to host response.

It has been shown that three distinct, partly interconvertible phases of fungal growth occur *in vivo*. In areas in which no specific host defence reaction is evident, a fine pseudomycelium of predominantly monaxial growth potential with elongate elements is characteristic. By a tendency to increase in cell division, such a mycelium gives rise at localised points to short verticils of blastospores derived by budding. From cultural investigations, NICKERSON, TABER & FALCONE (1956) have shown that 'the operation of a cellular division process appears to be superimposed on the growth process, and may operate (or not) without impairment to the rate of growth'. The basic pseudomycelial phase is capable of extensive colonisation of those areas of host tissue where no inflammatory reaction is evoked. It appears to be developed in circumstances comparable to those described by BAKER & BRAUDE (1956) for human tissues infected with *Coccidioides immitis*, where the fungus occurs in walled-off pulmonary cavities and acellular meningeal foci.

Where the basic pseudomycelium encounters an inflammatory exudate, morphological change becomes evident. A transitional mycelium of restricted polar growth, deeply constricted into short elements and subject to intense verticillation, then appears. It is suggested that this morphological development is the result of an increase in tendency towards cellular division, whereby the energy available for growth is directed into numerous hyphal axes. The result is a diminished power of spatial tissue colonisation, and the appearance of focal lesions, abscesses or granulomata in the host. GARRETT (1956) has pointed out that the rate of progress of infection will vary directly with mycelial momentum and inversely with host response in the case of many plant pathogens.

Redaelli (1924) regarded the type of mycelium described here as penetrative in nature, attributing its morphology to mechanical and chemical resistance on the part of the host. It has also been illustrated by Salazar Leite & horta (1945). As basic pseudomycelium can penetrate tissue without alteration in morphology, transitional mycelium seems likely to be initiated by chemical changes in the immediate environment. Direct phagocytosis by polymorphs is largely obviated owing to the size dimensions of the parasite. The effect of polymorphs is, however, to restrict monaxial fungal growth. Decrease in fungal growth appears to occur when necrosis of polymorphs and host tissue takes place. It is indicated firstly by degeneration and fragmentation of some fungal elements, and secondly by the appearance of distinct septation followed by enlargement and extreme vacuolation of the cells so delimited. The latter cells (bladder-cells) would appear to represent a resting or sclerotial phase. Both cell division and cell growth have presumably ceased. *In vitro*, this would result in the formation of chlamydospores (Nickerson & Manowski, 1953).

The role of histiocytes, which predominate towards the fringe of an abscess and are the dominant cell types in a granuloma, appears to be similar to that of polymorphs. The tendency towards cellular division which resulted in transitional mycelium is further increased within the zone of histiocytic infiltration. There is a distinct morphological trend towards a blastosporic phase derived by budding from the tips of verticils. Many blastospores undergo bladder-cell development.

It would seem that the filamentous phases of the parasite within the host are the most significant for tissue colonisation. This view supports those put forward by Salazar Leite & Horta (1945), Hill & Gebhardt (1956) and Young (1958), that the pathogenicity of *C. albicans* is dependent upon its development of a mycelial phase *in vivo*. Changes in the morphology of *C. albicans* similar to those described in the present paper have been observed by Hurd & Drake (1953) in rabbits treated with antiserum. They record the development of multibranched mycelium and thick-walled, distorted blastospores. The influence of leukocytes *in vitro* on *Coccidioides immitis* (Baker & Braude, 1956) accords with that described in this paper. They apparently facilitate segmental swelling of mycelium and degeneration of other segments.

Discussion

In attempting to delimit degrees of infection in mice affected by experimental moniliasis, host strain, degree of pathogenicity of the fungal isolate and inoculum density have been found to be of primary importance. The two latter have been referred to by MACKINNON & RODRIGUEZ-GARCIA (1935). Host strains of mice have received little attention, although strain CF-1 has been reported more resistant to *C. albicans* than strain RAP by HUPPERT, CAZIN & SMITH (1955).

With regard to the problem of the accurate estimation of infection degree in susceptible mice, two primary forms of disease, acute and chronic have been described. Their recognition points to the existence of a systemic form of resistance in the host. Acute disease is presumably the outcome of haematogenous dissemination of the parasite followed by a relatively rapid establishment of pseudomycelial phase, principally within the tissues of the kidney and heart. YOUNG (1958) states that blood cultures are positive after twenty four hours in mice intraperitoneally inoculated, irrespective of the virulence of the fungal isolate involved. He also regards the pancreatic blood vessels as those originally invaded from pancreatic lesions.

The chronic disease reaction appears to follow haematogenous dissemination without a subsequent intramatrical mycelial development in the renal cortex; blastospores are eliminated to the cavity of the renal pelvis where a pseudomycelium develops.

The systemic host resistance is apparently controlled by genetic means, as shown in mice of strain L, where infection leads to chronic rather than acute disease at higher densities of fungal inoculum. In a susceptible host, systemic resistance is also dependent on inoculum density, and must therefore be influenced, in part, by increase in inoculum potential, i.e. the energy of growth of a parasite available for infection of a host at the surface of a host organ to be infected (GARRETT, 1956). The nature of systemic resistance is unknown, but may be related to the functions of the reticulo-endothelial system or to a variety of humoral factors.

Local mechanisms of defence are in operation in both acute and chronic disease reactions. The reactions were described by PERUCHENA PEDACE (1929), but the chronic disease reaction outlined by them did not include the characteristic fungal colonisation of the cavity of the renal pelvis. It is suggested that the two disease reactions, as described in the present paper, afford an accurate means of estimating degree of infection. Although the kidney is widely regarded as the host organ most indicative of infection, the involvement of the musculature of the heart must be stressed as the most significant feature in acute disease.

It has been shown that fungal morphology may be used as an indication of the efficiency of local defence mechanisms in the host. Where a basic pseudomycelium of monaxial growth occurs intramatrically, host response to colonisation is minimal: where the development of transitional mycelium and/or bladder-cells occurs, the response is directed towards curtailment of further tissue colonisation.

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ISARIA CRETACEA VAN BEYMA

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(20.I.1959)

Recentemente, da bosco di Eucalipto, il Dr. A. Rambelli ha isolato un fungillo che fu facile determinare come *Isaria cretacea* van Beyma (1). Trattasi di un Ifomicete che non ci risulta elencato tra la micoflora italiana e neppure, al momento, segnalato presente nel terreno. Senza meno non si trova elencato nè nella rassegna di Niethammer (2), nè in quella più recente di Gilman (3). D'altronde, il raro rinvenimento ambientale può facilmente spiegarsi in quanto i rappresentanti di *Isaria* vivono in genere parassiti o saprofiti di Insetti, oppure in sterco od anche (più raramente) su detriti vegetali.

L'habitat di rinvenimento, piuttosto insolito anche se non proprio eccezionale, ci ha quindi suggerito di soffermarci su questa specie e di ridescriverne i principali caratteri.

Origine del ceppo.

Isolato nel luglio 1958, da terreno coltivato ad Eucalipto in località Borgo Grappa, presso Latina (Italia Centrale).

Caratteri dell'apparato vegetativo.

Il micelio è composto da ife ialine, leggermente clorine, ramificate, larghe da 2.5 a 3 micron, a calibro spesso irregolare, andamento sinuoso, con rigonfiamenti, specialmente in quelle mature, in prossimità dei setti. Pareti leggerissimamente echinulate e setti difficilmente visibili in quelle giovani. Contenuto protoplasmatico granuloso a maturità.

Fino dalle prime fasi di sviluppo il micelio tende a formare fascetti di cinque o dieci o più elementi. Tali ife hanno calibro più uniforme, setti e pareti facilmente visibili, contenuto protoplasmatico granuloso, pareti lisce. Si anastomizzano frequentemente fra di loro ed hanno andamento generalmente rettilineo.

Dalla riunione di due o più fascetti prendono origine i coremi. Questi ultimi, lunghi da 0.5 a 5 cm. secondo la natura del mezzo alimentare e larghi fino a 150—160 micron, sono di colore bianco niveo, a calibro generalmente uniforme; talvolta ripetutamente ramificati a circa due terzi di altezza, in bracci laterali lunghi fino a 2—3 mm. Talvolta leggermente ingrossati in prossimità dell' apice affusolato e, più spesso, della base (larga fino a 200—250 micron), coperta fino dalle prime fasi di sviluppo, da abbondanti fruttificazioni conidiche.

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[1]) Borsista del Consiglio Nazionale delle Ricerche del Brasile.

Le ife che compongono i coremi si ramificano abbondantemente verso l'esterno, tanto da ricoprirli con un apparato miceliare più o meno fitto, a seconda dello stadio di maturità.

Tale micelio è formato da ife relativamente sottili (larghe da 1.5 a 2.5 micron) ad andamento segnatamente sinuoso, contenuto protoplasmatico leggermente granuloso, a pareti e setti facilmente visibili e a caratteristiche cromatiche simili a quelle precedentemente descritte.

Talvolta il micelio organizza anche sorta di anelli o spirali ovali od allungate formate da una o due ife. Sono larghe 7.5 micron e lunghe da 13 a 20 micron.

Caratteri dell' apparato riproduttivo.

Conidiogeni fialidiformi, lunghi da 9 a 12.5 micron (raramente fino a 15 micron), leggermente rigonfiati, larghi da 2.5 a 3 micron, con apice allungato in uno o tre pedicelli fertili, sottilissimi, portanti conidi. Alla base si restringono fino a micron 1.5. Presentano le stesse caratteristi che cromatiche del micelio. Hanno pareti facilmente visibili, contenuto protoplasmatico omogeneo e sono facilmente colorabili con soluzione diluita al 0.5 % di bleu cotone in lattofenolo. L'apice è generalmente sullo stesso asse de fialide. Spesso però è rivolto lateramente od obliquamente.

Accanto a questo apparato riproduttivo ne esistono altri tipi a struttura relativamente semplice. Le fruttificazioni infatti sono prodotte, sia pure raramente, da conidiofori allungati (lunghi da 8.5 a 12.5 micron e larghi da 3 a 5), clorini o ialini, con due o tre, raramente più punti di differenziazione dei conidi. All'apice sono leggermente attenuati. La base si restringe fino a micron 1—1.5. Non hanno una forma costante e definita.

Finalmente i conidi possono anche essere prodotti da sorta di sterigmi lunghi fino a due micron.

Le ife fertili che portano contemporaneamente i tre tipi di apparati riproduttivi su descritti (fialidi, conidiofori e sterigmi) si innalzano, dalla base, aderenti alle pareti del coremio, che è generalmente sterile, più spesso seguono l'allungamento di quest'ultimo alla distanza di 2 o 3 mm.

I conidi sono ialini, più spesso clorini, ovali o leggermente apiculati, monocellulari, a pareti facilmente visibili, a contenuto protoplasmatico omogeneo. Misurano da 3 a 3.5 micron in larghezza e da 3.5 a 4.5 micron in lunghezza.

La fruttificazione avviene all'apice del fialide, mediante flussi plasmatici che, in seguito a maturazione, si trasformano in conidi muniti di un peduncolo sottilissimo, con il quale si inseriscono al punto di emissione. In genere ogni fialide porta 2—3—4 conidi. In altri termini, avanti la completa maturazione del primo conidio formato si ha l'emissione, dallo stesso fialide, di altri tre o quattro conidi che rimangono, uniti con il primo, a formare una sorta di glomerulo.

La maturazione dei conidi coincide con il disseccamento e la rottura del peduncolo che li unisce al fialide. I conidi divengono in questo modo indipendenti. Spesso però conservano, attaccato all' apice, piccole porzioni de peduncolo disseccato.

Osservaziono complementari.

Isaria cretacea van Beyma è specie auxo-eterotrofa. Infatti in mezzi liquidi minerali come il liquido di Czapek-Dox non cresce

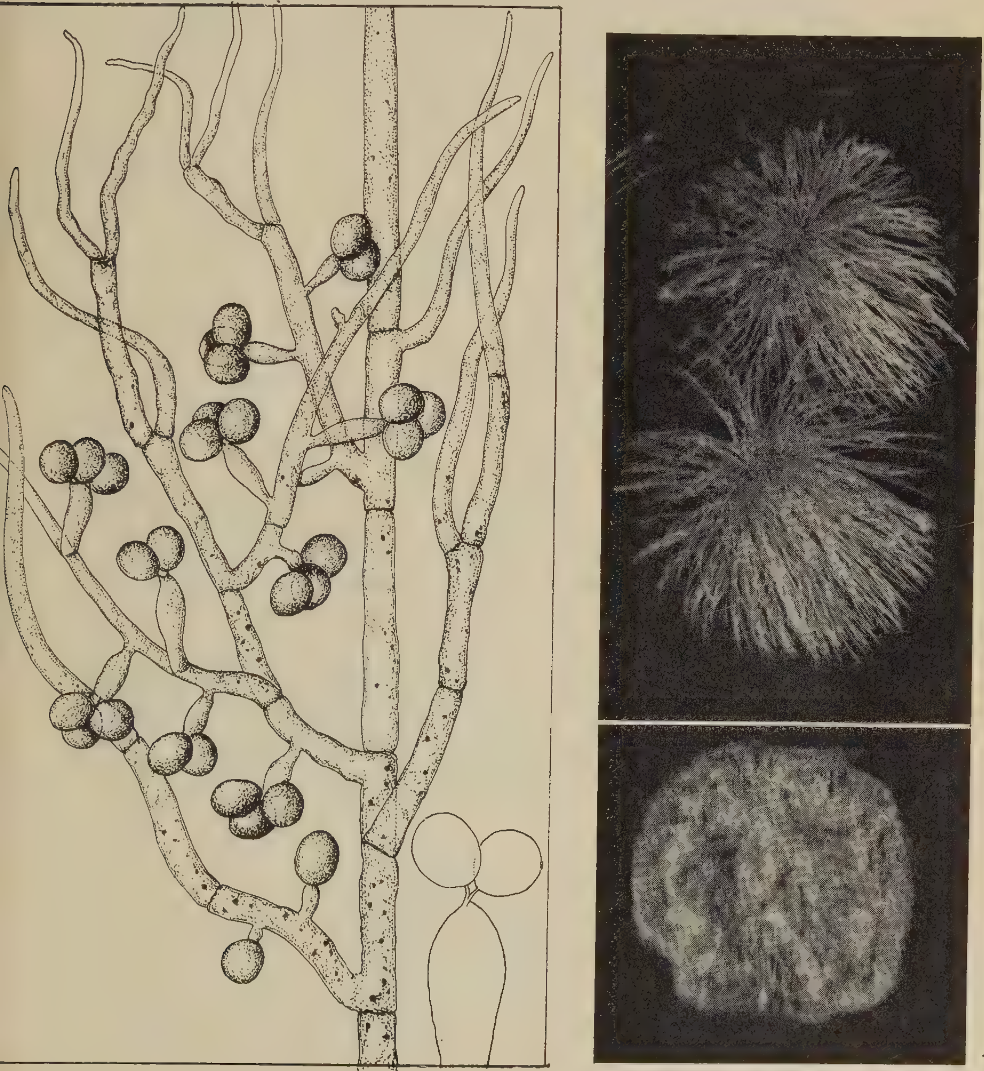

Fig. 1. Aspetto morfologico di *Isaria cretacea* van Beyma e aspetto colturale in carota (in alto) e in patata (in basso).

mentre un certo sviluppo si ha nei mezzi naturali (es. infuso di carote). In Czapek-Dox presente estratto di lievito o vitamine [1]) dopo un pò di tempo si nota uno sviluppo, anche se non molto rilevante, in seno al liquido. Se nel mezzo con vitamine si toglie tiamina tale sviluppo si fa un poco minore; se si toglie biotina lo sviluppo diviene quasi insignificante. Sembrerebbe potersi dedurre che *Isaria cretacea* VAN BEYMA è biotina-dipendente; con tutto ciò abbisogna di altri fattori poichè, anche con biotina, non si raggiunge nei mezzi sintetici lo stesso sviluppo che si ha nei mezzi naturali. E' interessante rilevare come, in Czapek-Dox con estratto di lievito il micelio si presenti relativamente ingrossato e con qualche irregolarità; fruttificazione assente. In Czapek-Dox con vitamine il micelio è un poco più sottile, ma abbondantemente fruttificato. Gli

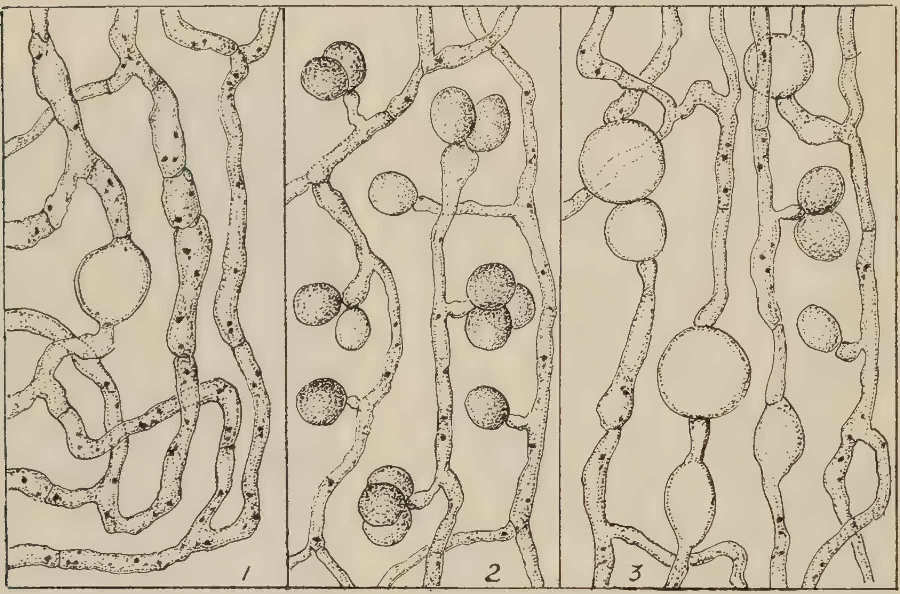

Fig. 2. Aspetto morfologico del micelio in liquido di Czapek-Dox addizionato di estratto di lievito (1), addizionato di vitamine (2), e addizionato di vitamine meno biotina (3).

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[1]) Vitamine aggiunte:

Biotina	mg/litro	0.005
tiamina	,,	1.—
cloridrato colina	,,	2.—
piridossina	,,	0.5
riboflavina	,,	0.5
inosite	,,	4.—
Ca-pantotenato	,,	2.—
niacina	,,	2.—
B12	,,	0.05

organi di fruttificazione sono peraltro semplici, non fialidiformi; nella generalità dei casi si tratta di una estroflessione dell'ifa, piuttosto corta, portante 2—3 o pochi conidi. In Czapek—Dox con vitamine meno tiamina il micelio non offre particolari deviazioni qualora si eccettui la presenza frequente di cellule globose, grandi sino a micron 15—18, con membrana non inspessita, normalmente vacuolizzate. Venendo meno biotina la scarsa vegetazione è rappresentata da micelio normale con più scarse cellule globose; fruttificazione relativamente abbondante, più che in assenza di tiamina.

In agar-fagiuoli saccarosato si formano colonie di non grande estensione il cui ritmo di crescita, a 26° C., è rappresentato dalla annessa figura. Presenza abbondante di coremi lunghi da 1 a 3 cm.; presenza, altresì, di gocce di traspirazione incolori. Reverso di colore giallo scuro.

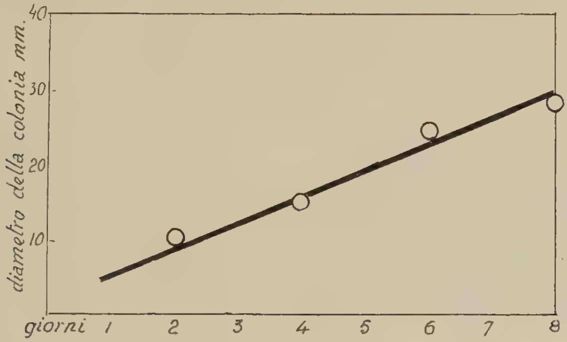

Fig. 3. Sviluppo di *Isaria cretacea* in agar-fagiuoli.

In agar-malto crescita pronta, abbondante, con formazione di numerosi e più o meno lunghi coremi. Assenza di gocce di traspirazione, reverso di color crema.

In agar Czapek e in agar Richard sviluppo scarso, relativamente lento, di mecelio bianco con assenza di coremi. Reverso bianco.

Su fette di carota lo sviluppo è ottimo con formazione pronta ed abbondante di coremi lunghi anche 3—4 cm. Su fette di patata lo sviluppo è invece più lento con formazione di coremi molto piccoli.

Finalmente *Isaria cretacea* VAN BEYMA si dimostra antagonizzare, in coltura, altre specie di funghi.

Riassunto

E' una breve nota descrittiva di *Isaria cretacea* VAN BEYMA isolata da terreno di bosco ad Eucalipto.

Trattasi di un Ifomicete non ancora segnalato presente in Italia e forse non ancora rinvenuto nel terreno.

E' specie auxo-eterotrofa e presenta attività antagonista verso altre specie di funghi.

Summary

The present note deals briefly with *Isaria cretacea* van Beyma, isolated from Eucaliptus soil. The fungus is a Hyphomycete whose presence in Italy was never noticed before and perhaps it is the first time the it is found in soil. This *Isaria* is an auxo-heterotrophic species and shows a certain antagonistic activity against some fungi.

Resumo

O presente trabalho é uma nota breve descritiva de *Isaria cretacea* van Beyma, isolada de terreno de um bosque de Eucaliptos. Tratase de um Ifomicete cuja presença na Italia não foi ainda assinalada e talvez seja a primeira vez que é isolada de terreno.
E' uma especie auxo-heterotrofica e apresenta uma certa atividade antagonista sobre outros fungos.

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SOME NEW DISEASES OF CITRUS IN PAKISTAN

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Sweet orange (*Citrus sinensis*-(LINN.) OSBECK locally known as malta orange; mandarin and tangerines (*C. reticulata* BLANCO var. *mandarin* and var. *tangerine*); lemon (*C. limon* (LINN.) BURM. f.); Grapefruit (*C. paradisi* MACFAYDEN); Shaddock (*C. decumana* MURR.) vern. *Chokotra;* lime (*C. aurantifolia* SWINGLE); sour or bitter orange (*C. aurantium* LINN. sub. sp. *amara* LINN.) Sweet lime (*C. aurantifolia* SWINGLE (= *C. limetta* RISSO) are important species of the Natural Order: Rutaceae, which are cultivated in Pakistan. In the former Punjab there are some sizeable plantations covering hundreds of acres at a stretch. But the majority of the orchards are not so large. They are often the mainstay of small farmers. Therefore, the value of individual trees becomes all the more in such cases. These species suffer from a number of diseases in Pakistan.

A lot of literature exists on fungi, bacteria and viruses causing citrus diseases in Italy (PETRI, 1927—31), U.S.A. & other countries. An excellent review of these exists in the standard reference work of H. S. FAWCETT (1936) "Citrus diseases and their control."

In Egypt, SIRAG-EL-DIN (1931—34) reported on gummosis of citrus and other diseases. In New Zealand, CUNNINGHAM (1925) has also reported some diseases on citrus.

In prepartition India work on citrus diseases was done by BUTLER (1918—30), BAL (1920), SUNDARARAMAN (1928), UPPAL & KAMAT (1925—27), KAMAT (1930—33), CHAUDHURI (1933, a. b.); CHEEMA & BHAT (1929), MITRA, M. (1929); MITRA, S. K. (1929); JOHAR (1931—32), DASTUR (1933) and SAHASRA BUDDHE (1927).

A number of diseases have been noted by the author on various citrus species which are described in the succeeding paragraphs. In order to bring out a clear picture of the symptoms it is necessary to briefly mention some of the diseases already known elsewhere but whose symptoms at one stage or the other resemble with the new diseases noted in this paper.

In Bark Rot major symptom is the exudation of foam or froth from the cracks in the bark. Old trees are more susceptible. This disease arises after drought and is the result of the growth of yeast and other fungi on weakened bark.

Bark blotch occurs on orange, mandarin and lemon as dark brown areas surrounded by lightly raised margins. The bark dies up to the wood and gradually the stem or branch is girdled. White greyish patches appear in which are embeded minute black bodies of the causal fungus-*Ascochyta corticola*. FAWCETT (1936) has described the disease in detail.

Decorticoses or shell bark due to *Diaporthe citri* (*Phomopsis californica*) affects the outer layers of bark. It spreads upwards from the bases of large limbs but in general is confined to bark on the trunk. Bark dies, shrinks, cracks and loosens in vertical strips. Drying, and cracking starts at the bud union near the soil and gradually works up, till the entire trunk is involved. In cases of shell bark alone that are not accompanied by gum diseases, the inner bark and cambium remain intact and tend to build up new layers to replace outer killed layers. Young bark appears to be immune to disease which is found only in connection with bark of considerable age in advancing disease. The disease occurs in a cycle of 4—5 years. The leaves turn bronze in colour and some fall prematurely leaving thin foliage. Shell bark may not do much damage as the bark cambium soon recovers and forms new tissues after the disease advances farther. The fungus is usually invisible to the naked eye in the diseased bark. Under certain conditions dark pycnidia or spore bearing bodies are found partly embeded in the surface of the dead strips of outer bark.

Shell bark is prevalent in moist conditions. It starts in slight injuries at the bud union. It is not known to attack anything except lemon bark. Eureka trees 15—20 years are most affected. Lisben lemon trees of 20—30 years begin to show its effects.

Diplodia gummosis due to *Diplodia natalensis* is usually accompanied by profuse gum ooze and localised killing of bark. It extends along the wood tissues much more rapidly than it invades bark which presents resistance and halts the progress. At first wood is merely discoloured and this paves the way for other fungi.

Leproses or nailhead rust is sometimes termed as scaly bark which term in California is used for psorosis with which it resembles in later stages. The leprosis is characterised by round or oval spots of mahogany red to chestnut brown raised above the surface. The bark becomes glazed and then brittle, cracking lengthwise. Spots coalesce in severe cases. The rough patches of bark shell off from the trunk and limbs. On fruit brown sunken spots or rings are seen. On leaves, spots are round light green or brown on the upper side and grey to brown on the underside. Whereas leprosis affects all the above ground parts but rarely leaves, this is not the case in psorosis. Leprosis only affects sweet orange while psorosis occurs on other species of citrus besides sweet orange, FAWCETT (1936). Leprosis has been reported from Pakistan by JOHAR (1931) but psorosis has not been definitely recorded although there is a strong possibility of its cocurrence here.

Exanthema as discussed by FAWCETT (1936) affects newer branches especially the terminal ones. It seldom affects main limbs and trunk. The branches and fruits become stained brownish, gum soaked, twigs are zigzag and show die back. Chlorosis, small leaves and gum pockets are manifest. Bark is raised into large blisters due to gum deposit between wood and bark. Bark excresences are formed along the terminal stem or near the base, in the bark of the fruit spurs or in the leaf axil among buds. New bark is formed from below and excresences are sloughed off. Multiple buds are seen in the leaf axil. Deep green thick and coarse leaves are present. Rosette growth from multiple buds takes place.

The writer suspects from some of his observations that this disease is also present in this country but further detailed observations are necessary.

Anthracnose (Withertip) is due to *Colletotrichum gloeosporioides*. It is accompanied by die-back of mature and nearly mature twigs, leaf and fruit. Fruit drop occur in sick trees. Fungus propagates on tissues weakened by climate, soil or other causes.

Malsecco is a serious disease of lemons due to *Deuterophoma tracheiphila* which invades wood. It is well dealt with by FAWCETT (1936). The disease is marked by sudden dying of the leaves and rapid dying back of twigs. Wood shows pinkish or reddish discolouration. In some cases the fungus extends from tips downwards. In older trees infection comes from root and lower part of the trunk. Fungus can be traced through wood due to slight discolouration that occurs. Sour orange, Sweet orange, lemon and trifoliata stocks are specially susceptible to this. It has not been observed so far by the author.

In localised state of Psorosis one or more hard irregular scales or flakes are sloughed off at first. In systemic condition pimples or pustules burst with gum ooze and scaling off occurs later. As the disease spreads further, scaling of bark occurs. In advanced stages large quantities of gum exudes.

In psorosis (FAWCETT, 1936) wood also shows discolouration and is drab grey or cinnamon drab. In some cases rufus colour is also seen. The stain progresses in an irregular manner not necessarily following the rings. The entire interior becomes stained except the wood just beneath the cambium. The wood is firm and hard unless secondary pathogens attack it. The strips of bark begin to slough off. In B-type of Psorosis gumming occurs previous to scaling. Progress of disease is rapid and scaling and gumming may spread several feet along one side at a time before the other side is affected. Mosaic affects on young leaves are seen. Water sprouts originate from badly diseased trunk or large limbs. Extreme irregularity in moisture is stated as one of the causes. Over watering and heavier soils increase the incidence. *Citrus sinensis* is the most susceptible species. Almost the entire wood except a narrow wood layer beneath the cambium may become stained.

Diseases in Pakistan

In Pakistan much more work is needed to fully know the diseases of citrus. It is probable that many other diseases may be noted in this country when intensive studies are carried out.

Recently HAFIZ (1956) has summed up a few common diseases of citrus. Controls have also been suggested for each. He has dealt with (i) Canker due to *Xanthomonas citri* which attacks limes, grapefruit and is also common to orange and sangtra. Lemons are worst affected (ii); withertip and fruit rot are caused by *Colletotrichum gloeosporioides* which when combined with malnutrition induces fruit fall. Earlier CHAUDHURI & JOHAR (1933, 1931) had done much work on this pathogen; (iii) Fusariosis of seedlings and root rot due to *Rhizoctonia* species are seen in nurseries in Pakistan.

Besides these fungi, little is known about the pathogenicity of the other fungi recorded on *Citrus* species. Amongst the fungi recorded by AHMAD (1956) are *Daldinia escholzii*, *Diplodia aurantii*, *Hypoxylon glomeratum*. Moreover, *Botryodiplodia* and *Fuscoporia* are recorded on *Citrus aurantium*. In addition to these *Alternaria citri*, *Cladosporium herbarum*, *Acrothecium*, *Eutypa*, *Haplosporella*, *Hypoxylon glomeratum* and *Pleospora herbarum* are also noted on other citrus species. *Colletotrichum gloeosporioides* is reported on *Citrus medica*. These studies deal primarily with the fungi themselves rather than their association with particular diseases. With the exception of this no further information is available. The writer had occasion to visit various citrus orchards and the observations made are recorded here.

1. *Ganoderma Root rot of Malta orange.*

In one of the orchards in Lyallpur district old sweet orange trees were seen gradually declining and a die-back was noticeable. The branches were pruned and trees were manured without suspecting the root rot. The trees produced new shoots but the die-back was again noted and large branches were killed. Ultimately only large limbs with tender adventitious shoots were left. After the rains in the third year fruit bodies of *Ganoderma lucidum* appeared. On exposing the roots white mycelium was seen underneath the bark forming a thin discontinuous sheath. On the surface of roots fine white mycelial threads were spreading. Other trees near the vicinity of the same locus showing similar symptoms were dug and roots were exposed. They also showed fungus infection.

It was clearly observable that the fungus had spread through root contacts. The roots showed a spongy texture and black zone lines in wood.

This fungus has also been reported on citrus from Palestine by REICHERT (1932) and reviewed by FAWCETT (1936).

Control:

The fungus presumably spreads on injured portions of root during interploughing and those trees which are debilitated due to other diseases like anthracnose or withertip are more prone to attack. The trees affected by the diseases were dug up and almost all the major roots which were generally confined to upper 3—4 ft. were cut at a depth of about 4 ft. The pits were covered and fodder crop was planted for 4 years when new plants were planted a little distance from the original site so that the old tap root in the earth if it still existed might not come in contact with the new plants soon. No adverse effects have been noted after 3 years.

2. *Fuscoporia leavigata:*

This fungus has been recorded from Lahore (AHMAD 1956). It is stated to attack the trunks of *Citrus reticulata* but beyond this little is known. Further observations are needed on this fungus.

3. *Scaly bark and canker:*

In Lyallpur district this disease is quite common especially on *Citrus sinensis* (Sweet or malta orange) and worst on *Citrus reticulata* Var. *mandarin* (SANGTRA). The localised symptoms in the early stages resemble Psorosis mentioned earlier (rough pimply condition without gumosis and longitudinal sloughing of the bark (FAWCETT 1936)).

There is no directional association of the spread of disease so far as the aspect or exposition is concerned. Its occurrence on individual limbs on all sides has been noted. The bark is at first darker in colour than normal with some glaze as if killed by frost which is not the case. There is an ooze which dries up bearing water mark appearance on the sides of the killed portion which has been dried up. The disease spreads longitudinally in strips and when the trunk portion is killed in a strip the lower roots are also affected and ultimately killed.

The branches are also killed when the strip spirals round. Mainly the bark is killed from the top to the bottom. The bark later on shows dark bodies embeded in the wood. Localised cankers are also seen on limbs. The bark exfoliates much late. It also forms blisters which later burst open as reflexed canker. Local eruptions often heal up and bark sloughs off (c. f. Pseudopsorosis). In late stages of infection the bark peels off in rectangular scales exposing canker which in turn is attacked by insects (stem borer). The branches which are affected bear heavily and then start dying. (Fig. 1). The wood in active infection shows an orange advancing zone and the wood further inside is stained dark grey. Sometimes alternating deep dark and light zones are seen along the rings. Finally the tree may be left as a big stub with a few appendages (Figs. 1—5).

Although *Botryodiplodia lecanidion* PETRI & SYD. (SPEG.) has been noted on *Citrus aurantium* earlier by AHMAD (1956) but during the present investigations *Hendersonula toruloidea* has been found to be constantly associated with the disease on *Citrus sinensis* and

Citrus reticulata Var. *mandarin*. It is a very serious disease and attacks generally the mature trees. It is also noted that *Diplodia theobrome*, commonly refered to as *Diplodia natalensis* on citrus, (Fig. 8), occurs mixed with the infection of *Hendersonula toruloidea* (Figs. 6—7) but in majority of cases only *Hendersonula* is noted. The author is, therefore, inclined to believe that *Hendersonula* is the primary pathogen and fluctuations in water supply may act as a predisposing factors. When Diplodia becomes associated with it, the syndromé becomes complex and belongs to no single Pathogen. The disease is, therefore, compared and constrasted with different diseases of citrus in the following paragraphs.

The disease seems to spread primarily from spore infection of *Hendersonula toruloidea* mainly during the rainy season. The course of rain water flow along the limb is generally followed by disease organism.

Hendersonula toruloidea NATTRASS was first described by NATTRAS in 1933 (NATTRASS) as serious gummosis and die-back disease of stone fruit trees in Egypt. Early symptoms in mature trees were wilting and die-back of twigs and branches, accompanied by a copious exudation of a gum-like substance. The tree itself succumbed slowly, one branch being affected followed later by others. Though the tree survived one or two seasons, the whole system eventually became involved. In other instances trees in their prime and in full bearing suddenly wilted, beads of gum-like substance were exuded from the lenticels and from the bases of the buds and leaf trusses, and death follows quickly. The fungus was also reported on apple but to less extent than on stone fruits. In no instance was the fungus isolated from citrus trees.

In spite of the fact that the fungus was invariably isolated from diseased and wilting plants, NATTRASS believed that the fungus was not a primary parasite and the initial symptoms of gumming was manifestation of physiological disturbances due either to over-irrigation or to fluctuation of the water table with inadequate drainage, following a high Nile.

It has since then been reported on *Ficus* and *Populus* from Cyprus on orange from S. Rhodesia; and *Manihot utilissima* in West Africa. This tropical fungus was first recorded on Mulberry (*Morus alba*) and Bakain (*Melia azedarach*) in Pakistan by KHAN (1955).

NATTRASS discussed in detail the development of the fructifications and it is not proposed to give them in detail. The observations carried out by the writer so far support his account. Salient characters have been reported elsewhere (KHAN, 1955).

It may be noted here that Bark blotch due to *Diaporthe citri* spreads from the bases of large limbs upwards whereas the scaly bark of orange as noted here spreads mainly downwards. The drying, cracking and sloughing off bark is similar to *Diaporthe* attack and can be easily mistaken for this. In bark blotch, the bark tends to build up new layers which has not been observed in this case. There

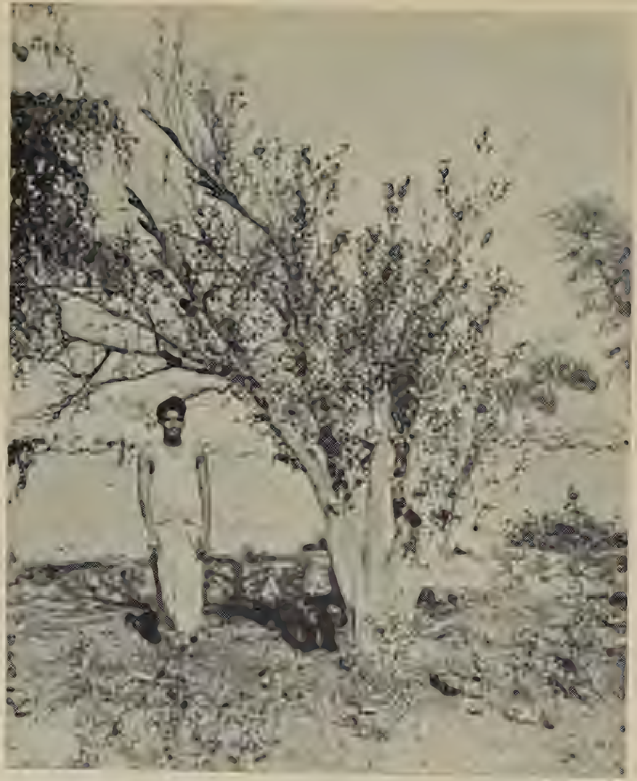


Fig. 1

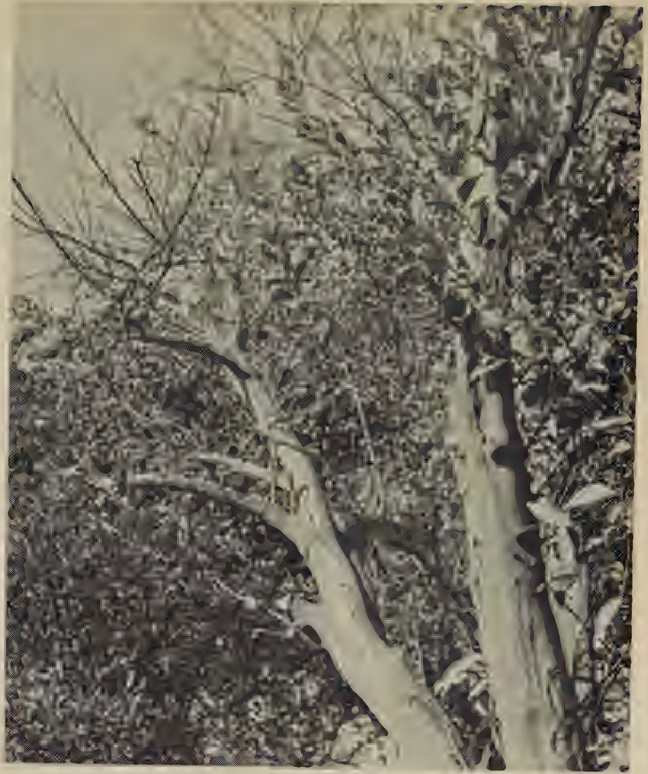
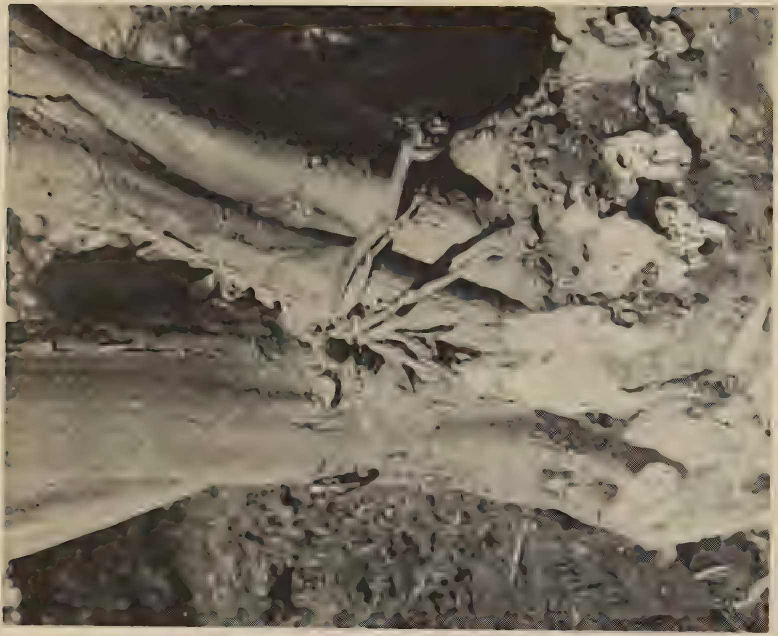


Fig. 2



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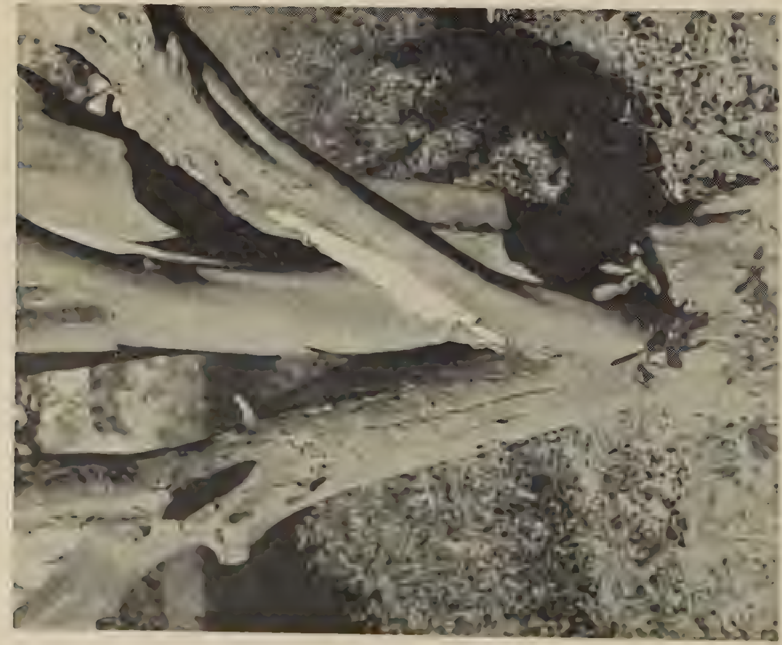

Fig. 3.

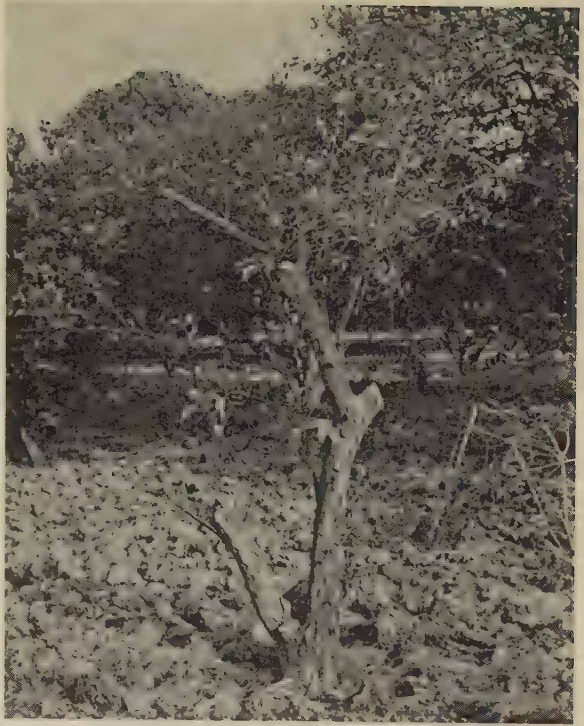

Fig. 5.

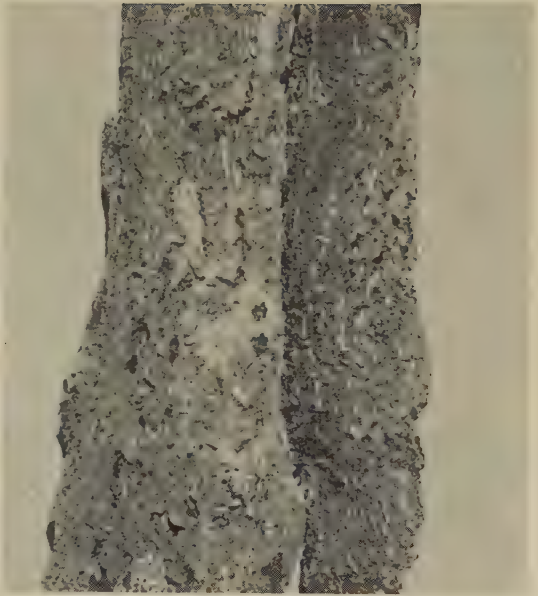

Fig. 6.

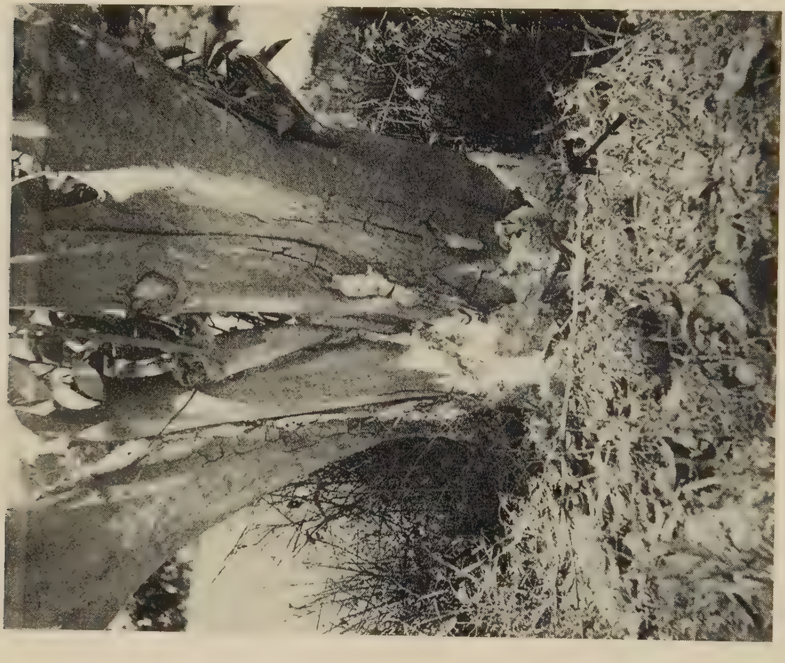

Fig. 9.

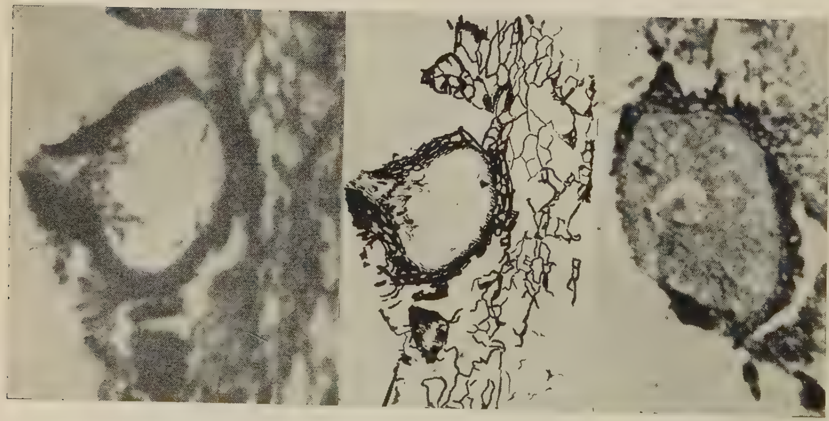

Fig. 7, 7a en 8.

is one similarity i.e. the comparative freedom from disease of the young bark and twigs. In the present disease the recovery of the cambium is seldom seen and canker formation invariably occurs. The shell bark occurs only on lemon but the present disease occurs mostly on sweet orange and mandarin.

This disease differs not only in the causal organism, from decorticosis or shell bark but also in the host range as the latter occurs only on lemon bark and not on sweet orange which is the case here. In shell bark, drying and cracking starts at the bud union near the soil surface and gradually works upwards which is not so in this disease. The present disease generally spreads from top to the base till the root system is also affected.

This disease has many symptoms in common with the psorosis and unless carefully noted it can be confused with other diseases. This disease has localised eruptions which however heal off. There is negligible gumming primarily on the margin even when this disease is extensive in deep contrast to psorosis where it is profuse. The bark scales off in precise rectangular scales while in psorosis the scaling is irregular. In this case the death of the bark is always in linear strips along one side but such is only manifest in very active state in psorosis-B type .The discolouration of wood is grey in both cases.

There is a light orange advancing zone in this disease which is seldom seen in psorosis. An alternate zoning of dark and light grey areas is seen along the rings which is not observed in psorosis.

Diplodia gummosis extends along the wood primarily and the bark presents resistance. There is no symptom of gummosis in this scaly bark and canker disease noted here. The wood is discoloured in advanced stages of infection.

Except for the occurrence of chestnut brown spots, the cracking of the bark lengthwise and later shelling off from the trunk and limbs is very similar both in leprosis and the disease noted in Lyallpur and Lahore areas. No effect is seen on the fruit which is normal except being poor in size and quality due to lack of vigour of the mother tree.

There are no bark excrescences as seen in exanthema. The gum soaked brown appearance of the branches can to a certain extent be confused with water soaked appearance of the bark in early progress of this disease. There are no multiple buds in this disease except for epicormic shoots arising from below the infected portion to repair the damage done.

This disease differs from Mal secco in the absence of sudden dying of the leaves though there is gradual thinning of the leaves. The die-back is gradual after the rains. The mode of spread of this disease is similar as both spread from tips downwards. The *Deuterophoma* is primarily trachaephilous and in older trees, spreads from roots and lower part of the trunk but in the present case the fungus has so far been seen to spread only from the branches towards the trunk or from the centre of a limb spreading in both directions, the downward spread being more than vertical up. Although the fungus in the present disease is primarily a bark disease yet it does affect the wood and causes discolouration in later stages. In final stage it may reach and discolour wood in the roots. (Fig. 4).

Control:

Small branches infected by this fungus should be cut and burnt. The dead bark with infected wood before the development of fruit bodies may be scraped off and besmeared with Bordeaux paste and covered with waterproof covering.

When larger limbs are affected, cutting them with about 18″ of healthy portion should help in restricting the disease. New shoots that arise below are always free from attack. Old trees where the disease has reached the roots, should be eradicated and roots grubbed up.

A careful programme of pruning and application of antiseptics should help in bringing the disease under control.

Citrus sinensis and C. aurantifolia Root rot

(Orange and sweet limes)

A visit to one of the citrus orchards in Lyallpur district during summer months revealed a root rot on sweet lime and orange trees. The fungus had spread in two acre plots which were flood irrigated from the same channel. The fungus was seen on mature fruiting trees. The symptoms on both these were similar and are given briefly as under:

Symptoms:

In summer a few days after irrigation when the soil was still very wet mycelial fans had come out from the base of the tree which apparently looked healthy, except for the slight flagging of leaves which could be due to fungus attack. In this tree dry and dead limbs had been pruned off earlier. In another tree the typical symptoms of die back, thinning of foliage and fruit bodies of the fungus were seen at the base. Dead trees had been grubbed up and removed. The roots were dug out and majority of roots was rot affected. The rotting wood was spongy. The fungus mycelium and fruit bodies seen at the base are shown in photograph (Fig. 9). The trees had died in patches as could be seen from the blanks in the plots of both the species.

There is strong evidence that the fungus spreads mainly through irrigation water and the injuries to roots and basal portion of stem due to ploughing might have formed courts of infection. The fungus it is estimated kills the trees in about two years i.e. two summers usually elapse before the tree finally dies and is removed.

Causal Agency:

The fungus in both the cases has been identified as *Poria ambigua* Bres. This is the first record of the fungus in West Pakistan on these species. It is a ubiquitous fungus which is a facultative parasite. It spreads rapidly under warm humid conditions as will be evident from the foregoing description of diseased trees and sites.

Poria ambigua Bres: Atti R. Acc. Sc. Lett. et Arti. degli, Agrati 3, ser. iii fasc. 1—2, 1897. — Fruit body spreading widely, upper margin often inflated to subreflexed, white, finally straw coloured to Isabelline; subicle membranous, closely adnate, white, tubes many and oblique to densely nodulose; mostly up to 8 mm. long. Pores somewhat larger, angular, finally dentate to lacerate (torn off). Spores hyaline obovate, 5—8 × 3—35 μ. Basidia clavate 18—20 × 6—8 μ, cystidia fusoid, apex muricellate (Purplish and projecting) to finally yellowish, 24—30 × 6—8 μ. Subhymenial hyphae delicate, tunicate, septate, 3—4 μ, broad.

This fungus has also been reported from Hungary on trunks of beach, carpinus, pyrus and *Prunus communis*. It is also known to attack *Robinia pseudoacacia*.

Control measures:

Trenching and isolation is very difficult under flood irrigation. It was advised that the trees should be converted and stumps dug out and burnt on the spot. The irrigation channels should be blocked and diverted so that water from the infected site does not pass into healthy areas.

The suspected and infected trees were all dug out. The wood including stumps was sold as fuel. The land was thoroughly ploughed and left fallow for one summer. Later it was put under fodder for about 3 years after which period new plants were put in the site. No new infections have been seen for the last two years.

Acknowledgement

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TAXONOMY OF HAPLOSPORANGIUM PARVUM

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The history of the fungus has been summarized by Carmichael (1951). *Haplosporangium parvum* has been first isolated from the lungs of mice and ground squirrel in Arizona by Emmons & Ashburn (1942) and later in Alberta by Dowding (1946) from the same animals. Since then, Jellison (1947, 1950) found the fungus in rock rabbits, weasels, skunks, as well as beavers and various other rodents, first in Montana, then in Minnesota, Texas, California, and British Columbia. The same student found this species on a Korean rodent *Apodesmus* (Jellison, 1954), while McDiarmid & Austwick (1954) isolated *H. parvum* from mole in Great Britain (see Tevis, 1956, for additional records) and Bakerspigel (1956, 1957) from Saskatchewan rodents. The first isolation in continental Europe has been that of Sweden on *Apodesmus* (Jellison, 1956).

Around 1950, during the isolation of fungi and actinomycetes from Italian soils, we cultivated a Moniliaceous species that has been preserved in our mycological collection and labeled as ?*Glenospora* sp. Unfortunately, we are now unable to locate the exact place and date of isolation. Later on, during a revision of the mycological collection, we were struck by the analogies between this culture and *H. parvum*.

The present study has been performed on the Italian strain as well as on seven other strains kindly made available by Dr. J. W. Carmichael, Provincial Laboratory of Public Health, Edmonton Canada.

The pathogenicity for laboratory animals has been tested by Battaglia (1957).

Description of the Italian strain

The colonies on laboratory media (Sabouraud, carrot and potato agar, cornmeal agar) are cottony, sometimes granular or floccose.

The cultures of some strains are fast growing, better at high temperature (about 35° C); around 20° C the growth is considerably slower. Little may be added to the previous descriptions on the microscopical morphology. Chlamydospores are rare and formed mainly on old cultures at the higher temperatures.

The development of the fungus has been followed with the slide culture method, in spite of the poor growth. The mycelium is hyaline, densely branched, reptant, also septate at an early stage, 1, 5—3 μ

in diameter. Short lateral branches of the same size or slightly narrower (1, 2—2, 5 μ) grow along the mature hyphae, but, in some case, also along the younger ones. As a rule the branches are irregularly alternated on each side, sometimes even opposite; the length varies from 1,5 to 15 μ or little more, as a rule 5—8 μ. The shape is straight or slightly curved, unbranched, narrowed and almost acute at the free end. On slide cultures the fertile branches are reptant, but in the common agar cultures they are more or less ascending.

The free end is soon inflated, producing an approximately spherical aleuria; in many cases, while the acrogenous conidium is present, one or two other aleuriae (up to 5—6) are produced on each aleuriophore. One of the most frequent configuration is that with two acrogenous aleuriae. As a rule the formation is centripetal but both aleuriae may be formed at the same time. In other cases, by previous inflation of the mother hyphae, a few sessile or almost sessile aleuriae are formed along the aleuriophores, opposite or alternate or irregular. The aleuriae may be separated by a short fragment of the aleuriophore or be strictly adjacent one to another.

In spite of the fact that the aleuriophores are narrowed at the tip and more or less inflated, thus simulating phialidia, they are not true phialidia, nor the conidia are of endogenous production (phialospores); the aleuria is merely produced by inflation of the aleuriophore.

Most of the aleuriae are spheric in shape, sometimes flattened at the top, rarely slightly ovate and depressed at the free end, even fusoidal-inflated. They are hyaline, without septa, from 2,5 to 6 μ in diameter, as a rule 3—4 μ, with a smooth epispore; we did not observe any double layer.

The aleuriae are not easily detached from the conidiophores, even on lactophenol mounting from the test-tube cultures. In any case, a small fragment of the mother hypha is appended to the aleuria. This fragment of the aleuriophore may be very short (1—1,5 μ) or longer or even absent.

The germination is easily observed on the surface of nutrient agar or in one drop of liquid medium or even in a drop of water, and it is similar to the germination of any common moniliaceous mold.

The figures of plate II were obtained by CARMICHAEL from cultures growing on Czapeck's agar in Riddel-type (1950) microcultures incubated at 25° C. The dark background was obtained with lacto-fuchsin mounting medium (CARMICHAEL, 1955).

Thermophily and nitrogen assimilation

Of the seven strains studied, four (S—129 = 1714; S—138 = 1710; S—395 = 1708 and S—349 = 1709) grew at room temperature (about 20° C); three (S—125 = 1716; S—134 = 1712 and the Italian strain 1225) around 30—35° C.

TABLE I.

Utilization of nitrogen sources (mg of dry mycelium from 100 ml of Richard's medium after 25 days of incubation at 20°C or 35°C; average of 3 replicates).

	Peptone	NH_4Cl	$NaNO_3$	Urea	Glicine	Leucine	Norleucine	Alanine	Phenylalanine	Glutam. acid	Aspartic acid	Arginine	Histidine	Proline
Haplosporangium bisporale . .	42	0	0	0	0	17	0	24	0	43	0	0	0	14
H. parvum 1714 (not thermophilous)	46	71	9	85R	50R	44	26	48	27	18	27	16	23	24
H. parvum 1710 (id.)	71	48B	20	152R	38R—W	26	27	29	45	25	21	41	27	31
H. parvum 1708 (id.)	163	5	0	92	13	23	13	37	21	26	38	31	0	0
H. parvum 1709 (id.)	111	52	0	39	26	11	17	9	9	14	14	0	0	0
H. parvum 1716 (thermophilous).	251	37	0	254	30	27	2	13	19	40	33	0	0	10
H. parvum 1712 (id.)	120	37	0	146R—L	50	45	81	24	31	62	48	0	0	23
H. parvum 1225 (id.)	85	27	0	64	18	25	30	19	25	27	51	0	0	0
H. parvum (general total averages)	121	40	0	119	32	29	28	26	25	30	33	0	0	0
H. parvum (averages thermophilic strains)	152	34	0	155	33	32	38	19	25	43	44	0	0	11
H. parvum (averages not thermophilic strains)	92	44	7	92	32	26	21	31	25	21	25	22	12	14

R = rose; W = white; L = lilac.

The nitrogen assimilation has been studied in 200 ml Erlenmeyers containing 100 ml of Richard's solution[1]). The following nitrogen compounds were used: ammonium chloride, urea, glycine, leucine, norleucine, alanine, phenylalanine, glutamic acid, aspartic acid, arginine, hystidine, proline and peptone (Difco). Each compound was used in amounts going a content of 25 mg of N for each 100 ml of Richard's solution. The dry weight of mycelium is the average of 3 replicates; the cultures were incubate for 25 days at 35° or 20° C.

To sum up, the best nitrogen sources for growth are peptone and urea to about the same extent, while ammonium chloride is able to support approximately one third of the growth. Glycine, leucine, norleucine, alanine, phenylalanine, glutamic and aspartic acid are assimilated to a lesser extent (about one fourth of pepton and urea) and arginine, hystidine, proline and sodium nitrate are unable to promote growth or only very little.

No significant difference is found between the assimilation of nitrogens of thermophilic and not-thermophilic strains.

According to the thermophily and the utilization of nitrogen sources a classification of the strains studied may be established.

For sake of convenience, the growth may be graded as follows: excellent growth = more than 250 mg; very good growth = =201—250 mg; good growth = 151—200 mg; intermediate growth = 101—150 mg; poor growth = 51—100 mg; very poor growth = = 50 mg or less.

A) Not thermophilic strains.
B) Very poor growth on ammonium chloride.
C) Good growth on urea, with pinkish colony; poor growth on peptone and very poor on sodium nitrate . . . . *Strain* 1710
CC) Good growth on peptone; poor growth on urea, with white colony; no growth on sodium nitrate *Strain* 1708
BB) Poor growth on ammonium chloride.
D) Intermediate growth on peptone; no growth on arginine, hystidine and proline; very poor growth on urea . . . . *Strain* 1709
DD) Very poor growth on peptone, arginine, hystidine and proline; poor growth on urea. . . . . . *Strain* 1714
AA) Thermophilic strains.
E) Very poor growth on proline.
F) Excellent growth on peptone and urea, and, on the last medium white colonies . . . . *Strain* 1716
FF) Intermediate growth on peptone and urea, on the last medium colonies pinkish to lilac . . . *Strain* 1712
EE) No growth on proline . . . . *Strain* 1225

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[1]) KH_2PO_4 5 g; $MgSO_4 . 7H_2O$ 2,5 g; $FeCl_3$ traces; glucose 34 g; bidistilled water 100 ml.

This classification, as compared with the ecological groups (northern strains and southern strains or Arizona — Texas strains, Montana — Idaho strains and Alberta strains) established by CARMICHAEL (1951) for the North American strains, is only partially coincident.

Comparison between H. bisporale and H. parvum

Through the courtesy of C. W. HESSELTINE (see 1943), we were able to compare *H. parvum* with a reisolation of *H. bisporale*. As previously stated by CARMICHAEL (1951), *H. bisporale* is a true Phycomycete, while *H. parvum* is but a Moniliaceous fungus. In liquid media the colonies of *H. bisporale* (plate I, A) are scattered and not fully developed, while the growth of *H. parvum* is, as a rule, plentiful, and covering all the free surface of the medium (see plate I, B, C).

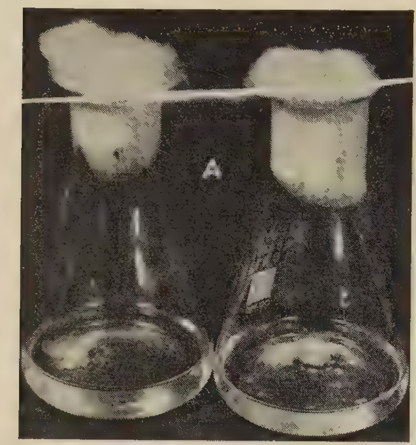
In addition (see Table I) *H. bisporale* is not developing on media containing ammonium chloride or urea, the best nitrogen sources being peptone and glutamic acid. *H. parvum* is growing in peptone as well as in urea, and, to a lesser extent, on ammonium chloride; glutamic acid is not an elective medium.

Experimental inoculation

CARMICHAEL (1951) reported the results of the subcutaneous inoculations of 10 *Haplosporangium* strains on guinea pigs and white mice. The Northern (Alberta and Montana) strains appeared more pathogenic than the Southern (Arizona en Texas) strains, the former giving rise to more permanent and more developed nodules. This author confirmed the conclusions of ASHBURN & EMMONS (1945), DOWDING (1947) and JELLISON (1950) that *H. parvum* does not multiply in the host, nor cause a progressive disease.

In Italy CARBONERA (1950) inoculated the EMMONS' strain No. 1214 from Arizona intraperitoneally, subcutaneously and intravenously in guinea pigs and mice, always with negative results, also after reinoculation. MENGES & HABERMANN (1954) too, obtained negative results. BATTAGLIA (1957) made a large series of inoculations comparing the pathogenicity of the Italian and Korean strains with those from Arizona, Alberta, Texas and Montana. The inoculations were made on guinea pigs first intraperitoneally, then by endocranial way. All the strains developed local, aspecific granulomata with adenopathy, but the Italian and Alberta (S 133) strains produced diffuse phlogose in lungs, liver and spleen, somewhat with central necrosis. Aleuriae were found in the peritoneal granulomata, lungs, liver and spleen; only occasionally in kidney (plate I).

The pathogenicity of the Italian strain, isolated from soil, appears to be equal of that of the Alberta strain S-133, the more pathogenic of the tested strains.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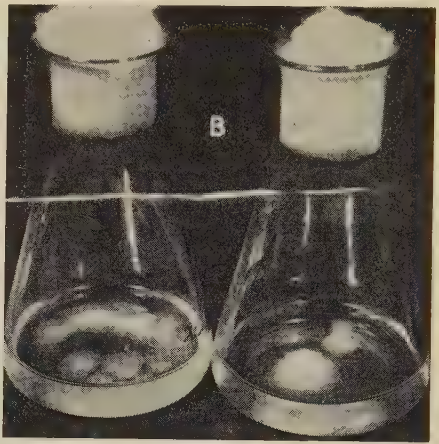
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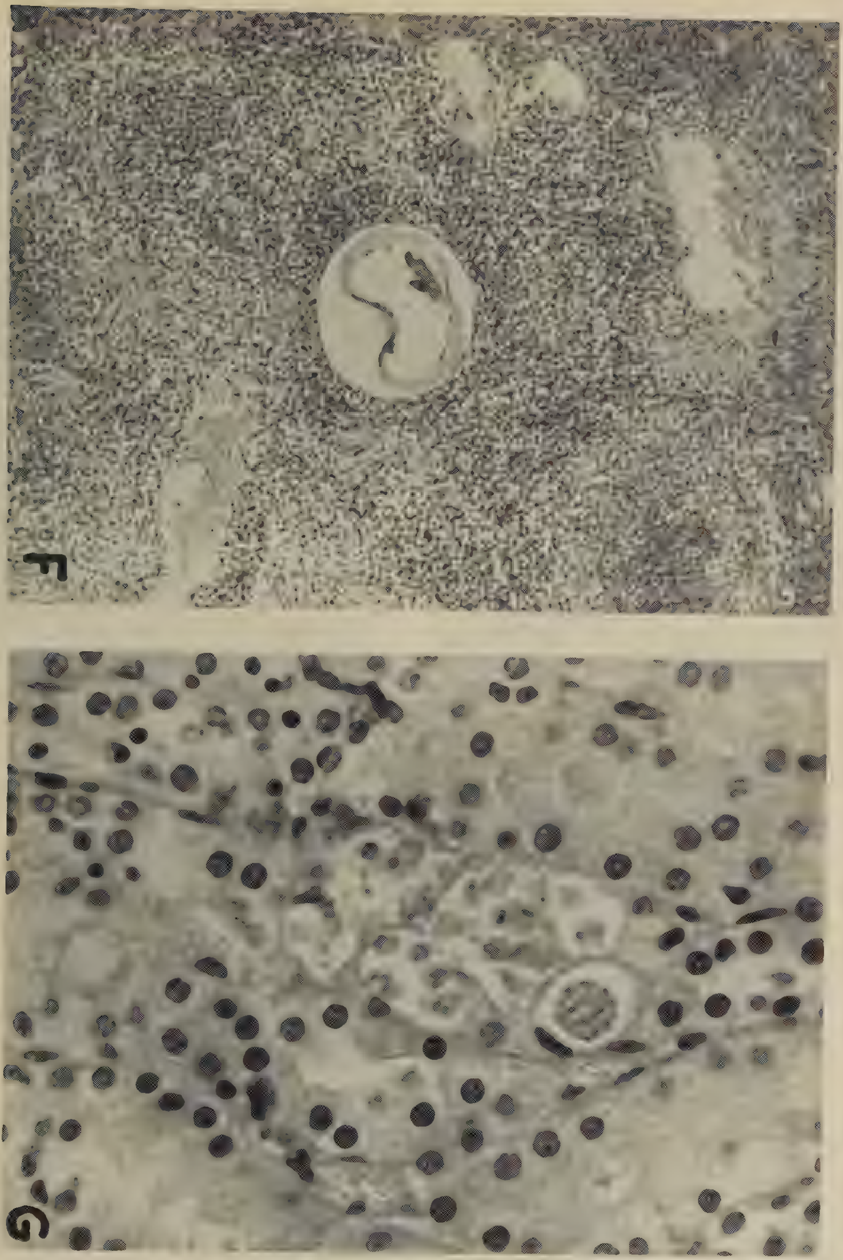
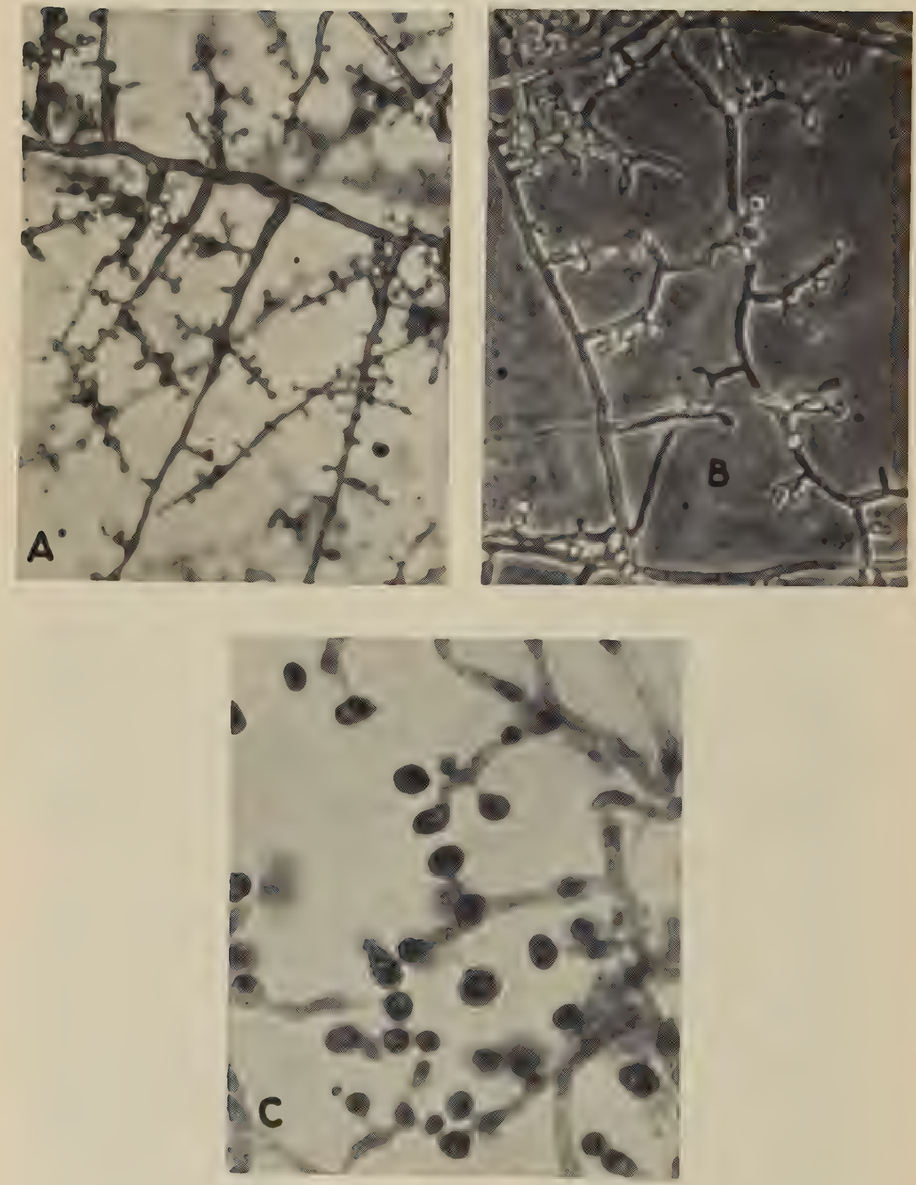


Plate I. Cultures and Experimental Inoculation of *Haplosporangium parvum.*

A) 22 days old cultures of *Haplosporangium bisporale* in Richard medium plus peptone; B) *Haplosporangium parvum* strain 1714, as above; C) *Haplosporangium parvum* strain 1716, as above; D) liver of inoculatedGuinea Pig with nodes produced by *Haplosporangium parvum*; E) lungs of the same animals; F) spleen with a large aleuria; G) kidney with aleuriae.

D) and E) one half of the natural, photos S. Battaglia; F) × 50, as above; G) × 290, as above.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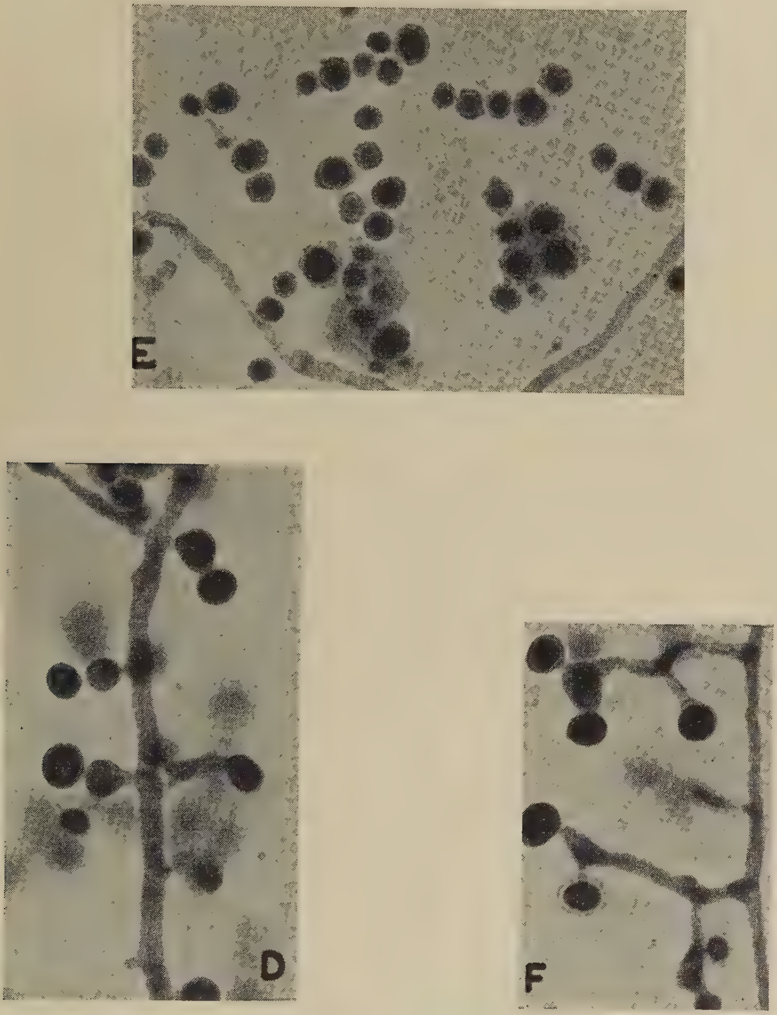

Plate II. Morphology of *Haplosporangium parvum.*
A) Conidia and conidiophores in air, from microculture 12 days old. Living material.
B) Young conidia and conidiophores showing general morphology, from microculture 6 days old. Living material.
C), D) and F) Details of conidia and conidia and conidiophores, from microcultures 14 days old. Lacto-fuchsin mount.
E) Mature conidia showing minutely tuberculate outer wall and thick, hyaline inner wall, and variation in size and shape, from microculture Lacto-fuchsin mount.
(All photographs are from cultures growing on Czapeck's agar in Riddell-type microcultures, made by Dr. J. W. Carmichael. A) without strain, × 320; B) phase contrast, × 534; C), D) and E) and F), × 1334).

Taxonomy

The genus *Haplosporangium* has been described by THAXTER (1914) with *H. bisporale* (apparently the type species) and the little known *H. decipiens*. A third species (*H. lignicola*) has been added by MARTIN (1937) and two additional species (*H. gracilis* and *H. fasciculatum*) were described by NICOT (1956).

At first *H. parvum* has been considered allied to *Coccidioides immitis*, but *Haplosporangium* is always devoid of endospores of any nature, so that this opinion is untenable. Even the relationships with Phycomycetes is hardly justifiable, not only for the invalidity of the criterium of double spore wall, as stated by CARMICHAEL (1951), but also for the early and abundant septation of the mycelic hyphae.

The genus *Haplosporangium* THAXTER has been critically studied by BJÖRLING (1936) and compared with *Mortierella* COEMANS. *H. bisporale* THAXT. and *H. decipiens* THAXT. were reduced to species of the genus *Mortierella* as *M. bisporalis* (THAXT.) BJÖRL. and *M. decipiens* (THAXT.) BJÖRL. (the former being allied with *M. oligospora* and *M. reticulata*) because: 1) the mycelial segments generating the sporangiophores are found only on aerial mycelium; 2) well defined species of *Mortierella* possess 2 spores (*M. reticulata* and others) or from 1 to 4 spores (*M. thaxteri*). In addition the so-called "mycelial conidia" or "stylospores" are but unisporal sporangioles[1]).

In any case, *Haplosporangium parvum* is unrelated to *Haplosporangium-Mortierella*, because in the former species there are not sporangia, but thallospores, and the mycelium is moniliaceous. In addition the nutritional requirements are different. On the base of the proeminence of the aleurospores as spores of vegetative multiplication *H. parvum* must be classified in the group (family) of Moniliaceous Aleurismaceae (Aleurismeae). It has been established by VUILLEMIN (1931) and based on the genus *Aleurisma* LINK (with *Corethropsis hominis* and a few, more or less doubtful species), and it is homologous to the group of Dematiaceous aleurismaceous fungi, typified by the doubtful genus *Glenospora* (in medical sense, unrelated with the conidial stage of *Septobasidium*).

As pointed out by DODGE (1935), the problem of the real significance of *Aleurisma* LINK is yet to be solved.

In any case *Haplosporangium parvum* is allied to *Aleurisma* only as any other genus possessing this particular kind of aleuriospores.

Another 'medical' genus allied to *Glenospora* is *Glenosporella* NANNIZZI in POLL. et NANN. (1930; see NANNIZZI, 1934), derived from *G. albiscicans* (NIEUWENHUIS) NANN. apud AGOSTINI (1930), presumably a strain of the polymorphic *Trichophyton* species of the

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[1]) The opinion of NICOT (1957) is different. Studying the two new species (*H. gracile* and *H. fasciculatum*), he confirmed the autonomy of the genus *Haplosporangium*, because the differentiation of fertile hyphae (or segments) for septation, cytoplasmatic inclusions and, frequently, diameter; simple or branched sporophores, well narrowed at the tip, and sporangia mono- or paucispored.

T. schoenleini group. *G. dermatitidis* AGOSTINI (1930) is another species unrecognizable with reasonable security.

A third species of the same genus is *Glenosporella loboi* FONSECA et ARÊA LEÃO (1940), the presumed causative agent of the cheloidian blastomycosis or Jorge Lobo's disease of the Amazon Valley. The identity of this etiological agent has been studied by one of us (CIFERRI et al., 1956). The Lobo strain is a fungus allied to *Paracoccidioides brasiliensis* (but we established the genus *Loboa* with the species *Loboa loboi* (FONS. et LEÃO) CIF. et al. for *Paracoccidioides loboi*). *Glenosporella loboi* is an atypical Aleurismaceous fungus, completely different from *Haplosporangium parvum*.

From the short descriptions and the schematic illustrations, H. *parvum* appears to be allied to the little known genus *Geomyces* TRAAEN (1914) with *G. vulgaris*, *G. sulphureus*, *G. auratus* and *G. cretaceous* TRAAEN isolated from norwegian soils. A number of these species were reisolated and redescribed by ROBAK (1932) from ground wood pulp in Norway.

G. auratus and *G. cretaceus* were revised by BISBY (1945) in an elaborate paper on *Sporotrichum carnis* BROOKS et HANSFORD (1923), a species allied to *S. chrysospermum* HARZ (1874) (not to the Linkian genus *Sporotrichum*), following the ideas of VUILLEMIN (1910, 1911) on human *Sporotrichum*.

The conclusion of BISBY is that both *Geomyces auratus* TRAAEN and *G. cretaceus* ROBAK are synonyms of *Sporotrichum carnis*, referred by him to the genus *Aleurisma* as *A. carnis* (BR. et HANSF.) BISBY. He proposed to accept *Aleurisma* LINK ex CHEV. emend. VUILLEMIN, as typified by *A. flavissimum*, an idea divergent from that of BROOKS & HANSFORD (1923), as well as from VUILLEMIN, in the later work (1931).

In any case, the genus *Geomyces* as described by TRAAEN ("Hyphae septated, hyaline; conidiophores upright, ramified successively arbour-like; at the branch apices short, acrogenous formed, chains of light coloured, oval, ovoid or almost pear-shaped conidia") is near *Haplosporangium* sensu EMMONS, and *G. vulgaris* is strictly allied, if not identic, with *H. parvum*.

Another genus certainly allied with *Geomyces* and *H. parvum* is *Staphylotrichum*, whose only species (*S. coccosporum*) has been recently described by NICOT & MEYER (1956) as frequent in rain forest soils in Belgian Congo. It is characterized by aleuriophores erect, septate, with a rigid base and a thick, brown wall; top hyaline, branched, fertile, forming solitary aleuriae (produced also by the mycelial hyphae), rounded or ovoid, not septate, brown, thick-walled. This genus has been compared with *Botryotrychum* (another aleuriosporic genus), allied to *Staphylotrichum* but with sterile setae (and phialospores, according DOWNING, 1953).

In conclusion, all the above illustrated genera are near *Haplosporangium parvum*, but none is coincident[1]).

[1]) According BRESLAW (1955) and BLANK (1957) also the composition of the wall cell of *H. parvum* is quite peculiar.

The different opinions on the position of *Haplosporangium* THAXTER (a synonym of *Mortierella* as proposed by BJÖRLING or a different genus as proposed by NICOT), suggest to be inopportune to validate *Haplosporangium* EMMONS. We are then proposing a new genus, to be dedicated to the first discoverer of the fungus, C. W. EMMONS:

EMMONSIA, n. gen.

Moniliaceous, aleurioidal; hyalin, septate hyphae; conidiophores (aleuriophores) ascending, short, hyaline, branched and unseptate, irregularly distributed along the sterile hypha, alternate, opposite or irregular, producing at the top a conidium (aleuria), rarely more than one along the same aleuriophore, acrogenous or acropleurogenous; conidia (aleuriae) rarely subsessile to sessile, hyaline, spheric, not septate.

EMMONSIA, n. gen.

Mucedinaceous, aleurismeus, macronemeus; mycelio hyalino, ramoso, septato; conidiophora brevia, hyalina, non ramosa nec septata, irregulariter distributa, adscendentia, alternantia vel opposita aut irregulariter distributa; conidia (aleuria) singula acrogena, rarius plurima acropleurogena, sphaerica, hyalina, continua, etiam subsessilia, rarius sessilia.

Typus: *Emmonsia parva* (EMM. et ASHB.) n. comb.
Syn.: *Haplosporangium parvum* EMMONS et ASHBURN.

In conclusion the Authors are deeply indebted to Dr. J. W. CARMICHAEL for criticism and microphothographs.

Summary

A strain of *Haplosporangium parvum* has been isolated from Italian soil. It has been comparatively studied with six North American and a Korean strain. Two American and the Italian strains are thermophilic (opt. about 35° C) while the other four grow better at temperatures around 20° C.

The assimilation of nitrogen sources has been comparatively studied. In addition to peptone *H. parvum* metabolizes urea and most aminoacids, while *H. bisporale* assimilates peptone, leucine, alanine, glutamic acid and proline only. On the basis of N assimilation and thermophily, a key of the studied strain is established.

A comparison of *H. bisporale* with *H. parvum*, confirmed that the former species is a Phycomycete, while the latter is a Moniliaceous, aleuriosporic fungus. All the strains are feebly pathogenic, but the virulence of the Italian soil isolate is equal to that of the most virulent strains isolated from animal lungs (Alberta, Canada).

The taxonomy of *H. parvum* has been studied in relation to the more or less allied genera *Aleurisma*, *Glenosporella*, *Geomyces* and *Staphylotrichum*.

It is concluded that *H. parvum* may be better classified as a new genus, and the monotypic genus *Emmonsia* with *E. parva* (EMM. et ASHB.) n. comb. is proposed, although the entire group of aleuriosporaceous fungi needs revision.

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LES BASES D'UN ACCORD ENTRE DERMATOLOGISTES ET MYCOLOGUES SUR UNE CLASSIFICATION UNIQUE DES DERMATOPHYTES

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(18.XI.1958)

Les diverses classifications (Ota & Langeron 1923, Grigoraki 1924, Vuillemin 1925, Brumpt 1927, Guiart & Grigoraki 1928, Langeron & Milochevitch 1930), introduites, entre 1923 et 1930, ont été souvent critiquées par des savants compétents, comme les Professeurs Dodge et Benedek, et les nouveaux noms introduits ont été qualifiés de futiles et inutiles. Il en est résulté que nous avons actuellement trois classifications dans les divers pays.

Ces confusions ont été motivées par les causes que voici:

1°. Les savants qui ont introduit de nouvelles classifications n'étaient pas Dermatologistes et se sont surtout préoccupé à faire adopter chacun sa propre classification et sans s'occuper des bases de diagnose que j'ai donné en 1924 et qui ont servi à ces classifications et ce qui était plus important que l'introduction de nouveaux noms.

2°. Le Prof. Brumpt (1927), a utilisé ces mêmes bases de diagnose 1924 et les a appliqué aux genres de la classification Ota & Langeron 1923, et ce qui a créé de la confusion parce qu'il a laissé croire que les genres de cette classification 1923, avaient la priorité et qu'ils avaient une valeur, qu'en réalité ils n'avaient pas.

3°. Langeron & Milochevitch (1930), ont commis la même erreur que Brumpt et en ont ajouté une autre, en affirmant que mes bases de diagnoses 1924 qu'ils ont utilisé sans les citer, les ont obtenu grâce aux milieux dits naturels, tandis que ces bases ne se développent pas dans ces milieux.

4°. M. Langeron dans son livre 1946, a réuni les résultats de nombreux travaux qu'il a publié de 1930 à 1940 dans les Annales de Parasitologie avec plusieurs de ses élèves. Ces résultats dans leur ensemble ne faisaient que confirmer, sans les citer, ce que j'ai publié moi-même de 1924 à 1929, mais l'erreur qu'il a fait, était qu'en acceptant certaines bases, conserve des anciennes thèses opposées à ces bases. En effet, si une espèce se modifie par dégradation pléomorphe irréversible, c'est à dire héréditaire, on ne peut en même temps accepter qu'on peut empêcher cette transformation sous l'influence d'un milieu naturel. C'est un non-sens qui déroute le lecteur et crée de la confusion.

Toutes ces raisons me conduisent à revenir encore ici sur les bases que j'ai donné en 1924 pour éclaircir les faits et nous nous rendrons alors compte que ces mêmes bases peuvent aussi bien s'appliquer aux anciens noms cliniques *Microsporon, Achorion, Trichophyton, Epidermophyton* et ce qui pourrait supprimer les trois classifications qui existent actuellement, et concilier Dermatologistes et Mycologues pour une classification unique. Les noms de classifications importe peu, l'essentiel étant les bases qui définissent ces noms. C'est le tort que j'ai eu en 1924, d'introduire de nouveaux noms, mais je croyais que ceux qui ont donné par la suite d'autres classifications, auraient respecté les lois de nomenclature et la priorité de mes textes, mais j'ai appris avec l'âge, que la vérité est souvent celle qu'on a le pouvoir d'imposer et non celle qu'on doit adopter par droit légitime.

LES BASES DE DIAGNOSE DES DERMATOPHYTES

1ère Base – La loi de spécificité de Sabouraud (1894).

Pour les Dermatologistes, ce qui est important, sont les caractères cliniques des lésions, que nous appelons: Favus, Microsporie, Trichophytie et Epidermophytie et ce sont ces types cliniques qui ont donné leur nom aux parasites que nous appelons: *Microsporon, Achorion, Trichophyton, Epidermophyton,* comme nous le faisons pour les maladies microbiennes.

C'est de cette liaison entre la maladie et son parasite, dont s'est servi SABOURAUD, pour formuler en 1894, ce qu'il a appelé ,,Loi de spécificité'' et sur laquelle a fondé sa classification clinique.

Cette loi de spécificité, à la suite de mes recherches, m'a paru erronée et ce qui m'a conduit en 1924, de la modifier par le texte que voici:

,,Divers champignons parasites, appartenant à des espèces, genres et groupes très différents, peuvent être la cause d'un même syndrôme mycosique et, une seule espèce peut causer plusieurs types de lésions. La nomenclature mycologique établie, d'après la nature clinique des lésions, et suivant les conceptions que nous avons sur les maladies microbiennes, se trouve donc erronée; elle a été cause que l'on a réuni dans le même genre, où dans le même groupe, des espèces mycologiquement très différentes . . .''

Maurice LANGERON, collaborateur du Professeur BRUMPT, reproduit ce texte dans son livre 1946, p. 508 et 509, sans me citer, dans les termes que voici:

,,Aux trois principes de la Mycologie Médicale, énoncés au début de cet ouvrage, il y a lieu d'en ajouter deux autres:

1°. ,,Le polymorphisme des lésions; un seul champignon pouvant déterminer plusieurs types de lésions.

2°. La pluralité étiologique; un même type clinique de mycose pouvant être produit par des champignons très différents.''

Ces principes, dit-il, sont en opposition avec la loi de spécificité de SABOURAUD. Je ne crois pas avoir écrit autre chose en 1924 pour que M. LANGERON me dise à la page 537 de son livre: „que je n'ai pas respecté ce principe" que j'ai créé en 1924.

Voici maintenant les raisons qui m'ont conduit en 1924 à modifier cette loi de spécificité:

Achorion Schoenleini, parasite du Favus, est une espèce morphologiquement semblable au *Microsporon ferrugineum*, et la séparation de ces deux espèces à deux genres différents est erronée.

Le même *Achorion Schoenleini*, porte le même nom de genre que *Achorion gypseum*, malgré que cette deuxième espèce est tout à fait différente, parce qu'on les a isolé d'une lésion du type *Favus*.

Achorion gypseum et *Microsporon fulvum*, sont séparés en deux genres différents, parce qu'ils ont été isolés de lésions différentes, tandis qu'ils sont mycologiquement semblables.

Un autre inconvénient de la loi de spécificité est qu'elle nous empêche de connaître des espèces inconnues, comme les *Aleurisma*, que j'ai décrit pour la première fois en 1924 en collaboration avec le Dermatologiste MASSIAS, puis avec MAGROU et FAYET en 1926, et que LANGERON a décrit plus tard avec un de ses élèves dans les Annales de Parasitologie de Paris, et dans son livre 1946, comme s'il en était l'auteur et sans nous citer.

Deux ans plus tard, après mon exposé 1924, MM. RAVAUD, BASCH et RABAUD, Dermatologistes avisés de l'Hôpital Saint-Louis, ont décrit dans les Annales de Dermatologie de Paris, une épidémie de 95 cas de Mycoses avec des types cliniques différents, dûe à une seule espèce *Microsporon felineum* et récemment, j'ai rencontré en Grèce, une épidémie de Mycoses dûe à une seule espèce, *Achorion violaceum*, et dont les types de lésions étaient variables. On trouve dans la bibliographie des épidémies semblables.

Le Prof. MAGNUSSON (1928) a établi dans une statistique très étendue, faite en Suède, que les Actinomycoses bovines peuvent être causées, non seulement par des Actinomycès, mais également par de simples bacilles pyogènes, et un autre savant suédois NAESLUND, a confirmé ces faits en 1931.

J'ai remarqué aussi dès 1924, par l'analyse des Mycoses connues, qu'elles sont causées par des parasites différents (Mycétomes, Sporotrichoses), mais personne n'y faisait attention, parce que tout était dominé par la loi de spécificité que nous avons hérité de la Microbiologie.

Tous ces faits établissent d'une façon indiscutable que la loi de spécificité n'a pas une valeur absolue et que la nouvelle base que j'ai introduite en 1924, et que j'ai discuté, avant de la publier, avec le grand Dermatologiste BROCQ, est exacte. Par la suite, les Professeurs J. GUIART, BRUMPT, LANGERON, ainsi que la plupart des Dermatologistes et Mycologues l'ont accepté.

Ces principes n'excluent pas certes, la fréquence avec laquelle certains parasites d'un pays donné, dominent certaines lésions, mais ce n'est pas là une raison pour l'imposer comme loi générale et ce qui créait de la confusion, parce qu'elle multipliait les espèces et les Dermatologistes savent combien la race, l'âge, le terrain, le climat, etc. . . influencent le type de la lésion; le parasite n'est pas la cause unique dans la constitution du type anatomopathologique de la lésion.

Une des conséquences de cette nouvelle base a été la réduction du nombre des espèces et ce qui est accepté par Brumpt et M. Langeron, mais ce fait est également rapporté par ces savants comme s'ils en étaient auteurs.

2ème Base – Les vieilles cultures.

Pour faire la diagnose d'un champignon parasite, on examinait depuis toujours, comme en Microbiologie, des cultures jeunes, parce qu'on croyait que les cultures en vieillissant s'altèrent et ne sont pas bonnes pour définir la diagnose des espèces. Nous décrivions alors, pour définir l'espèce, toutes les formes que nous trouvons dans les cultures jeunes, soit: Diverses formes des filaments, diverses formes de conidies, diverses formes de duvets pléomorphes et ce sont ces formes que nous voyons dans la 2ème partie botanique du livre de Sabouraud ,,Les Teignes'' et dans tous nos livres de Mycologie et Parasitologie.

De toutes ces formes, les plus importantes pour la diagnose étaient les conidies, mais dans les cultures jeunes ces conidies ne sont pas encore développées, ni en forme, ni en nombre et ce qui nous empêchait de voir leur valeur.

J'ai suivi les cultures jeunes de 1918 à 1923, mais tout paraissait une jungle confuse et, j'étais décidé de renoncer à mes recherches complètement découragé.

Voici alors ce qui m'a fait reprendre courage et patience:

Un jour en me promenant, je me suis arrêté devant la vitrine d'un fleuriste et je voyais les roses dont la couleur variait suivant les plantes, et je me suis dit qu'on ne pourrait pas distinguer la couleur des roses avant qu'elles poussent, par la tige et les feuilles du rosier; j'ai déduit qu'il fallait peut-être laisser vieillir mes cultures pour voir les formes de reproduction, come on laisse pousser les roses pour voir leur couleur, ou on laisse vieillir les graines d'une plante et ce qui rend la graine capable de reproduire la plante.

J'ai pensé aussi que la base la plus solide pour la diagnose d'une espèce est de voir ses graines reproduire l'espèce et ce que personne n'a figuré. C'est ainsi que j'ai laissé vieillir les cultures et j'ai constaté que le vieillissement fait disparaître tous les filaments du mycelium comme disparaissent les feuilles d'une plante vieillie; en effet, les filaments de la culture se désintègrent et la matière nucléoplasmatique se transforme en corps reproducteurs ou conidies, par un mécanisme que j'ai précisé.

Les champignons parasites ne sont pas comme les champignons saprophytes, qui produisent des conidies au cours de la végétation.

Les champignons parasites doivent vieillir pour former leurs conidies abondamment, parce que la conidie résulte ici, sauf rares exceptions, de la désintégration des filaments et de la rétraction de la matière nucléoplasmatique en formes de reproduction que nous trouvons au stade de vieillissement, et qui sont seules à survivre en très grand nombre. Il est donc essentiel de laisser vieillir les cultures pour voir l'ensemble des corps reproducteurs — conidies, sans filaments, et ce sont ces corps reproducteurs — conidies qui m'ont servi de base pour la diagnose des espèces.

J'ai décrit cette base à la fin de la page 1424, de ma note publiée dans les Comptes Rendus de l'Académie des Sciences 1924, et M. LANGERON développe cette même base dans son livre 1946, p. 252, et où il écrit textuellement, sans me citer:

„Ce stade (de vieillissement) est le seul important pour l'étude taxonomique et pour établir la diagnose des espèces."

M. LANGERON, développe la sporulation des fusarium et des saprophytes en plusieurs pages et ce qui n'est pas la même chose que la sporulation des parasites, parce que les saprophytes produisent des conidies dès le début de leur végétation et les conidies se détachent sans que le mycelium disparaisse comme le font les parasites. Plus loin, dans son livre, décrit la formation des conidies ou aleuries produites par rétraction, mais il en attribue le mécanisme et le mérite à son maître VUILLEMIN, qui n'a jamais rien fait sur les Dermatophytes, sauf la classification 1925, dont les bases, sauf les noms, ont été prises dans mon texte 1924.

C'est cette base de vieillissement des cultures qui m'a permis de faire connaître en 1924, les Macroconidies, les Microconidies, les Arthrospores et les Vestiges des formes sexuées, qui ont servi pour la diagnose de toutes les classifications publiées en France entre 1923 et 1930, y compris celle publiée par OTA & LANGERON en 1923.

3ème Base – Influence du milieu et pléomorphisme.

E. BODIN, dont on ne parle pas beaucoup, malgré l'importance de son oeuvre, nous a fait connaître, pour la première fois, le pléomorphisme des champignons parasites en décrivant avec LAMY en 1897, *Microsporon canis* et ce travail est devenu la base de toutes nos descriptions mycologiques.

E. BODIN, ayant envoyé une culture de son *Microsporon canis* a R. SABOURAUD, ce dernier a changé le nom de cette espèce en *Microsporon lanosum*, parce qu'il n'a pas trouvé les mêmes formes, décrites par E. BODIN, et il a cru que ce dernier s'était trompé. En réalité, ce sont les formes qui ont changé et SABOURAUD était sincère, mais on ignorait que les formes peuvent changer et même disparaître, qu'il s'agisse de filaments ou de conidies.

Pour tous les savants, le pléomorphisme était un duvet de filaments qui couvrait la surface des cultures et que ces duvets étaient particuliers à quelques espèces. On les décrivait alors comme un caractère botanique de diagnose de ces espèces, en plus des autres caractères morphologiques, et ce que nous trouvons dans le livre classique de R. SABOURAUD et les livres de Parasitologie de l'époque. Enfin, on croyait qu'on peut éviter ce pléomorphisme par un milieu de conservation et ce que j'ai écrit être erroné. J'ai publié dans les Annales de Dermatologie, Avril 1929, une lettre du Directeur du Laboratoire de Baarn, Madame WESTERDIJK, dans laquelle il est dit que les milieux de conservation (gélose — peptone), utilisés depuis 15 ans, n'empêchent pas le pléomorphisme et ce qui confirmait la thèse que j'ai exposé. J'ai publié cette lettre pour répondre à R. SABOURAUD, à propos du milieu de conservation et R. SABOURAUD m'a répondu que seul l'avenir nous départagera. Cinq ans plus tard R. SABOURAUD a dit dans une conférence faite à l'Université d'Athènes, que j'avais raison. Je crois que depuis on a cessé d'utiliser ce milieu, comme Madame WESTERDIJK de Baarn (Hollande) l'a précisé plus tard en introduisant d'autres milieux.

Telles étaient nos connaissances sur le pléomorphisme, et voici dans quelles circonstances, j'ai modifié ce principe et j'ai précisé son mécanisme et par là même l'influence du milieu auquel nous croyions depuis DARWIN et AUGUSTE COMTE, pour expliquer le transformisme des espèces. Les termes Pléomorphisme, polymorphisme, transformisme et influence du milieu expriment en réalité le même fait que nous appelons influence des facteurs externes ou influence du milieu et qui s'appliquent au transformisme de toutes les espèces, et les termes pléomorphisme et polymorphisme sont utilisés pour les micro-organismes. Voici maintenant ce qui m'a conduit á modifier cette base:

Un soir de 1922, je sortais du Laboratoire de la Sorbonne, tard dans la nuit, et en passant sur un pont de la Seine, j'ai vu une femme enjamber le parapet du pont et sauter dans l'eau. J'ai couru pour la sauver, sans arriver à temps, et j'ai eu une telle émotion que j'ai marché toute la nuit le long de la Seine sans pouvoir dormir. Je pensais comment tout finit dans le monde par mourir, et que la mort est une fin inéluctable et je me suis demandé alors pourquoi les champignons parasites ne meurent pas et on croit que sous l'influence du milieu on peut les conserver éternellement. La conservation éternelle des espèces que les spécialistes des problèmes de l'évolution appelaient Panchronisme, d'après des fossiles dont on ignore la structure, est un principe erroné et, comme les champignons parasites n'ont pas de sexualité pour se renouveler, doivent mourir plus vite que les autres espèces et c'est pourquoi se pléomorphisent plus rapidement.

Enfin, je pensais aussi que la mort n'est que le terme d'un vieillissement progressif que subit l'individu et l'espèce et la mort n'est que la phase finale de cette sénescence progressive.

Avec ces pensées, j'ai commencé des recherches cytologiques en partant des conidies originelles de vieilles cultures de champignons parasites et en suivant leurs structures jusqu' à la mort de l'espèce et pour activer cette mort, je les faisais végéter à une température optima de 25° où j'ai fait agir les rayons X comme GOLDSCHMIDT & MULLER l'ont fait plus tard pour les mouches Drosophiles et leurs larves.

Pour plusieurs espèces le nombre des noyaux par cellule, au stade de germination, varie de 5 à 10, et progressivement ce nombre diminue jusqu'à un seul noyau, et celui-ci finalement disparaît, quand l'espèce est vitalement épuisée par le pléomorphisme.

La cause de cette sénescence est la nutrition, la respiration et le métabolisme et la conséquence est l'altération des structures par diminution des nucléoprotéïdes à poids moléculaire élevé et ce qui modifie les structures, les formes et les fonctions de l'espèce. De cette sénescence on ne peut certes se rendre compte sans l'analyse cytologique des espèces pendant une longue durée.

Les facteurs physiques et la composition du milieu nutritif peuvent modifier la vitesse de l'altération des structures, mais ne peuvent l'empêcher et la vraie cause du transformisme ne sont pas les facteurs externes, qu'on désigne par le terme ,,milieu'' mais les facteurs internes, dûs au métabolisme et ce qui altère les structures, et a comme conséquence, les changements des formes et des fonctions de l'espèce. Le duvet pléomorphe des surfaces n'est que le terme apparent de cette altération progressive, mais pour qu'il soit visible, il faut que les filaments soient longs et ce qui est le cas chez certaines espèces vitalement plus fortes, d'origine animale qui ont de plus longs filaments quand ils évoluent en milieu favorable, et c'est ce que nous appelons duvet pléomorphe des surfaces.

La cellule en s'altérant n'arrive plus à former les conidies des cultures originelles et celles-ci deviennent de plus en plus petites, parce que la matière nucléoplasmatique des filaments s'appauvrit et ce qui arrive au cours de l'évolution de ces espèces. Les macroconidies, dont les plus grosses mesurent jusqu'à 75 μ de longueur, deviennent des chlamydospores de 5—6 μ et finalement des microconidies de 2—3 μ de diamètre. Les rayons X, comme la température et l'aération activent le métabolisme et par conséquent la sénescence cellulaire, mais ce ne sont pas ces facteurs externes qui provoquent la sénescence et le transformisme, mais la sénescence cellulaire provoquée par les oxydo-réductions du métabolisme et dont les facteurs physiques accusent la vitesse. Le transformisme est une conséquence de facteurs internes liés eux-mêmes aux facteurs externes représentés par la nutrition.

Ces principes de sénescence que j'ai résumé en 1924 et analysé en 1925, dans ma thèse de Sciences en 300 pages, je les ai repris en 1936 et 1944 et j'ai fait, avec la sexualité, la base d'une évolution cyclique des espèces. Dans le Colloque International (Paris 1950), le rapport fait sur la Sénescence par le Professeur C. ARAMBOURG s'exprime dans le même sens et quant à l'évolution cyclique des espèces, le Prof. CHADEFAUD de la Sorbonne, parmi d'autres, a repris cette question en Janvier 1957, dans la revue ,,Naturalia'' en trois articles, sous le titre ,,La Biologie de la Mort'' et où il développe exactement les bases que j'ai donné dans mon livre 1944, p. 171.

Voici maintenant le texte que j'ai publié en 1924 sur l'influence du milieu et le pléomorphisme des Dermatophytes:

,,Dans tous les milieux de culture, les Dermatophytes se pléomorphisent. Ce pléomorphisme qui est une forme spéciale de polymorphisme se manifeste par une dégradation du mycelium et des corps reproducteurs. Cette dégradation est constante, mais elle est plus ou moins longue à apparaître, suivant les milieux et les espèces, elle se manifeste, soit dès les premières cultures ou à la suite d'un grand nombre d'ensemencements et dans un temps qui varie de trois mois à trois ans. Des facteurs biochimiques ou physiques influent sur le temps de son apparition qui peut devenir ainsi plus ou moins long; mais néanmoins, cette dégradation est constante et se manifeste toujours et dans n'importe quelles conditions. Ce pléomorphisme se traduit par les modifications suivantes:

a. Apparition d'un duvet blanc pléomorphique qu'on observe microscopiquement dans les cultures.

b. Amincissement des filaments, allongement et régularisation des parois des articles et vacuolisation plus accentuée.

c. Simplification des corps reproducteurs dont la forme marche de pair avec une diminution de la densité du cytoplasme.

Les fuseaux que nous considérons comme caractéristiques de certaines espèces subissent une modification dans le nombre de leurs loges qui tend à diminuer et finalement à un stade de dégradation plus avancée, ces fuseaux ne sont constitués que par une seule loge et prennent ainsi un caractère de grosses chlamydospores: ces dernières mêmes, à leur tour, diminuent de volume et se transforment en petites chlamydospores correspondant aux corps reproducteurs aleuries. En dernier lieu, le mycelium peut finir par devenir absolument stérile.''

M. LANGERON dans son livre 1946, p. 445, s'exprime dans les mêmes termes:

,,Ce pléomorphisme consiste en ce que progressivement les colonies perdent leur aspect caractéristique et se transforment en un duvet stérile de plus en plus envahissant: peu à peu les macroconidies, et les microconidies disparaissent . . .''

Sur le même sujet M. LANGERON & S. MILOCHEVITCH (Annales de Parasitologie, 1937, p. 177), écrivent: ,,Sur l'irréversibilité du pléomorphisme et la faillite de tous les procédés de régénération.''

Sur la réduction de la virulence que j'ai décrit également en 1924, p. 1425, M. LANGERON reproduit ces résultats à la page 446 de son livre 1946, sans me citer.

Analyse Cytologique du Pléomorphisme

Nos livres ne donnent jamais de figures de germination de conidies pour la simple raison qu'on ne les a jamais vues. Pour les voir, il faut ensemencer les conidies de cultures très âgées, parce qu'elles ont atteint leurs formes parfaites et elles peuvent germer normalement. On ne peut faire germer la graine d'un haricot quand le haricot qui porte la graine est encore vert. Il faut laisser mûrir le haricot et la graine pour pouvoir l'ensemencer.

En partant d'une culture très âgée, on constate que les conidies dont est composée la culture étant ensemencées dans un nouveau milieu subissent d'abord un gonflement par adsorption d'eau et ce gonflement aboutit à augmenter le volume de la conidie et à rendre à la matière nucléoplasmatique un aspect homogène et transparent, tandis que la membrane elle-même, sous l'effet de ce gonflement, s'amincit et prend l'aspect d'un liséré fin brillant. C'est sur ces formes seulement, d'un aspect homogène, qu'on peut faire des recherches cytologiques.

Ce premier stade est suivi par une végétation de 2 à 4 filaments, quand il s'agit de grosses conidies, comme les macroconidies, tandis que les toutes petites conidies n'offrent qu'un seul filament germinatif, parce qu'elles sont vitalement plus faibles.

La vitesse de cette germination et végétation est influencée par la composition du milieu et la gélose — maltose — peptone sont indispensables et ainsi qu'une température optima de 25° pour une vitesse de végétation identique. Une influence favorable est exercée aussi par une légère hydratation de la surface du milieu gélosé qui ne doit pas être complètement sèche et ce qui m'a conduit à utiliser par la suite des géloses plus molles en diminuant légèrement le taux du agar dans le milieu gélosé. Enfin, un procédé de végétation plus rapide est l'aération par l'étalement de la gélose molle sur des lames que nous plaçons sur une étagère déposée sur une assiette contenant de l'eau et couverte d'un globe. On ensemence la surface du milieu étalé sur la lame, par les conidies de la vieille culture que nous diluons dans un peu d'eau et nous plaçons le tout à 25°. L'aération libre facilite la vitesse de croissance et ce que M. Langeron décrit dans son livre 1946, comme une méthode nouvelle avec mille détails en s'attribuant l'invention, tandis que j'ai eu souvent l'occasion de lui faire voir cette méthode lors de mes recherches et je lui ai indiqué que cette méthode est très utile pour la germination des conidies et, en général pour augmenter la vitesse de végétation des formes végétatives, sans pour autant craindre les infections secondaires, parce que celles-ci ne se produisent que très difficilement quand l'espèce a été adaptée au milieu saprophytique. L'infection secondaire est à craindre surtout quand nous faisons un prélèvement sur les lésions et que nous voulons isoler l'espèce pour la première fois sur un milieu saprophytique ou s'adapte difficilement, surtout avec les cultures glabres.

A la germination, les conidies prennent un aspect homogène, se gonflent et les membranes deviennent minces au point que la fixation par le formol et la coloration des noyaux devient très facile et ce qui m'a permis d'analyser la structure de toutes ces espèces et ce que je ne pouvais pas faire avant d'utiliser les conidies de vieilles cultures. C'est par ce moyen que j'ai étudié les noyaux des conidies, leur nombre, leur mode de division que nous appelons amitose et j'ai suivi la croissance au cours de la végétation des filaments.

Les filaments végétatifs procèdent à leur développement poussé à leur extrémité par une masse riche en protoplasma et noyaux et chaque fois qu'il y a un arrêt dans la végétation, le noyau se divise et l'espèce développe parfois des filaments latéraux et quand cette marche s'arrête à la fin de sa végétation, il peut se produire localement un gonflement qui ramasse tout ce qui reste comme matière nucléoplasmatique et ce que nous appelons dans les parasites du favus, chandeliers faviques, et chez les Actinomycès et le B.K., actinophytes et formes massuées.

Au cours de réensemencements successifs qu'on fait subir à cette culture, on constate que peu à peu, tous les aspects de la culture originelle isolée d'un malade, se modifient avec les réensemencements d'une manière qui est toujours la même pour une quarantaine d'espèces que j'ai analysé, et que j'ai décrit en 1925.

Le saprophytisme est une nutrition qui augmente par hydrolyse la fluidité du protoplasma et ce qui lui permet de végéter plus vite, quand il s'est adapté au saprophytisme. Si ce protoplasma était à ses débuts épais comme la paraffine, il devient ensuite comme de l'huile et finalement comme de l'eau. Ces changements physiques augmentent la vitesse de vègétation et les cellules s'allongent et se gonflent par l'eau du milieu saprophytique et apparaissent plus grosses, plus longues et irrégulières et ce sont ces aspects qui rendent la culture polymorphe. Par la suite, la vitesse de végétation augmente davantage et les formes s'allongent de plus en plus, tandis que leurs parois prennent une certaine régularité quand le rythme d'assimilation et la vitesse de végétation s'est équilibrée au point qu'á la fin, les formes s'allongent à tel point qu'elles offrent un calibre petit et égal et ce sont ces formes qui donnent leur aspect aux duvets pléomorphes que nous observons à l'œil nu sur les surfaces des cultures et que nous appelons duvets pléomorphes. Enfin, nous disons que ces duvets sont dûs à l'influence du milieu et sans savoir que c'est la nutrition qui est la cause et que celle-ci provoque l'altération de la structure et ce qui modifie les formes en filaments minces pléomorphes.

Si nous tenons compte aussi qu'une culture est composée d'éléments de structure variable au point de vue nucléoplasmatique et que la vitesse de végétation varie avec l'emplacement des formes de la culture en profondeur, en surface ou sur les bords, ce qui influence la nutrition et la vitesse de végétation, on comprend les multiples raisons pour lesquelles les formes deviennent polymorphes. Pourtant quand on examine le terme de cette évolution, il est toujours le même: C'est le filament mince stérile et ce terme indique la marche biologique de cette évolution.

L'espèce passe par une phase originelle pendant laquelle la forme s'exprime morphologiquement par ses caractères héréditaires; puis par la suite, elle passe par une première phase de son altération, pendant laquelle les formes augmentent leur volume, et l'inégalité de la vitesse de végétation détermine leur polymorphisme et quand ce processus continue on arrive à atteindre la phase finale où toutes ces formes deviennent semblables, monomorphes, très pauvres en matière nucléoplasmatique et ce qui produit des filaments très minces, très allongés et presque stériles. C'est ce mécanisme qui a été à l'origine du terme Sénescence que j'ai adopté et qui est la vraie cause du transformisme, le milieu n'étant qu'une cause indirecte.

Les altérations morphologiques sont la conséquence de l'altération des structures, parce que dans les cultures originelles, on trouve 5 à 10 noyaux, mais par la suite leur nombre diminue progressivement et, finalement, on trouve un seul noyau. Les formes originelles sont remplies de réserves glycogéniques que nous colorons facilement au lugol, tandis que, par la suite, ce glycogène disparaît peu à peu et, dans les phases intermédiaires, on ne trouve que de petites plages de glycogène concentrées sur les points où la matière nucléoplasmatique est particulièrement riche, tandis que, dans la phase finale de l'altération cellulaire, ce glycogène disparaît totalement. Il en est de même du chondriome filamenteux que nous trouvons parfois dans les cultures originelles et qui, par la suite, disparaît et il en est ainsi, également des granulations métachromatiques et de tout autre élément du métabolisme cellulaire. Enfin, les pigments secrétés par certaines espèces, diminuent peu à peu pour arriver, à la fin, à être éliminés totalement.

Ce que nous venons d'exposer s'applique à tous les champignons parasites, mais la vitesse de l'altération varie avec les espèces et nous en avons trouvé qui s'altèrent très rapidement, surtout ceux dont les corps reproducteurs sont représentés dans les cultures originelles par de petites conidies irrégulières de forme instable, tandis que ceux qui se reproduisent par ce que nous appelons macroconidies — fuseaux, ou les arthrospores de cultures glabres ou les formes levures par bourgeonnement des cultures plâtreuses, sont plus stables.

Dans les milieux naturels qui sont pauvres, comme dans les milieux sans sucre de gélose peptonée, les cultures n'arrivent à produire que des formes chétives, car la cellule est mal nourrie et la culture devient pléomorphe par dénutrition en produisant de petits filaments minces. La preuve que si nous ensemençons ces cultures sur milieu d'épreuve, nous n'obtenons pas les formes de la culture originelle.

On peut ralentir le pléomorphisme et l'altération de l'espèce par la méthode du changement fréquent du milieu nutritif et en utilisant des milieux spéciaux, comme ceux que propose Madame WESTERDIJK, mais tout ce qui vit subit une mort progressive et qui se produit d'autant plus vite qu'il n'y a pas de sexualité et que la vie de l'espèce est plus active. Il n'y a que la conservation des spores dans le vide et en basse température qui peut, à mon sens, faire durer l'espèce ou à la rigueur, utiliser une atmosphère d'azote après avoir créé le vide et fermé hermétiquement en soudant les tubes où on veut conserver les conidies pour anihiler toute activité vitale.

En tenant compte des effets du pléomorphisme, jai déduit que la diagnose de l'espèce doit être basée sur les formes conidiennes des cultures âgées, mais non encore pléomorphes, et j'ai exposé les preuves de cette degradation dans les Annales des Sciences Naturelles, Botanique, 1925, p. 165 à 444 sur plusieurs espèces et la première espèce *Microsporon canis* sur laquelle j'ai développé l'altération des structures, des formes et des fonctions, comprend un texte de 30 pages environ.

Il est admis aujourd'hui que ce ne sont pas les facteurs externes qui influencent le transformisme de l'espèce, mais surtout les facteurs internes qui sont propres à l'espèce et, c'est leur ensemble qui détermine la sénescence et le transformisme puis la mort de l'espèce.

Les Formes de Réproduction et leur Altération

Quand on laisse vieillir une culture originelle de *Microsporon canis*, et qu'on examine au microscope une petite quantité de consistance poudreuse que nous prélevons sur la culture, on constate un grand nombre de macroconidies, lesquelles mesurent 20 à 30 μ de large environ sur 50 à 75 μ de longueur suivant les espèces. Plus la culture est originelle et plus ses formes de reproduction sont semblables et de dimensions relativement égales.

A côté de ces macroconidies de cultures originelles, nous voyons de microconides variables et on en trouve qui ont un diamètre qui varie de 2 à 6 μ environ et ces dimensions n'ont pas des limites fixes.

Plus nous faisons subir à la culture des réensemencements, plus le nombre de macroconidies diminue, tandis que celui des microconidies augmente et finalement les macroconidies disparaissent et les microconidies subsistent toutes seules. Par la suite leur nombre diminue et leur volume diminue jusqu'aux limites de la visibilité.

Les macroconidies contiennent en général un grand nombre de noyaux que nous pouvons observer, si nous les plaçons dans un nouveau milieu et en partant de vieilles cultures qu'on examine 24 ou 48 heures après, c'est à dire au stade de germination.

Si nous prélevons les microconidies que nous trouvons plus facilement sur la surface des cultures pléomorphes et qu'on les ensemence sur un nouveau milieu de gélose maltosée et peptonée et en maintenant la surface du milieu un peu humide, on constate que ces microconidies se gonflent et produisent en général une seule forme végétative par conidie, mais les plus petites de ces formes étant vitalement plus faibles, parce qu'elles sont très pauvres en matière nucléoplasmatique, produisent souvent un petit filament qui après avoir atteint une certaine longueur se courbe et se flétrit, parce que la conidie n'a pas assez de vitalité pour faire développer un filament, même de petit calibre. Ces toutes petites conidies n'ont pas en général un noyau visible et ce qui concorde avec la diminution de leur vitalité et par conséquent de leur pouvoir de germination. Je précise ces faits ici à cause de leur importance pour les mutations récessives et irreversibles et pour des problèmes microbiologiques qui sont difficiles à comprendre sans la connaissance de ces transformations qui se produisent chez tous les micro-organismes.

4ème Base — L'influence du Parasitisme.

Plus tard, dans les Comptes Rendus de l'Académie des Sciences 1933, page 61, j'ai complété l'action du Parasitisme dans les termes que voici: ,,Cette analyse cytologique des parasites démontre d'une part, que la densité du protoplasma est à la base de la morphologie des cellules, et que d'autre part, cette densité est très élevée dans la cellule parasite, à cause de sa nutrition par un tissu de nature animale dont la teneur en lipides est élevée.''

,,Nous avons donc pensé que pour conserver l'équilibre originel du cytoplasma parasite, il faudrait maintenir un mode de nutrition analogue à celui offert par le parasitisme et qui contient des lipides. Nous avons alors essayé des milieux à base de tissu animal: foie, reins, cervelle, sang coagulé, pulpe de rate, etc. . . .'' A cette même époque, j'ai essayé des cultures sur l'embryon du poulet, mais je n'ai pas publié ce travail.

L'action des lipides a comme conséquence d'augmenter le nombre des noyaux dans la cellule, comme nous le voyons chez les champinons parasites par l'augmentation des nucléoprotéïdes et ce qui nous explique la façon dont la cellule végétale peut évoluer en cellule animale; c'est cette influence des lipides que nous ne connaissions pas ainsi que les rapports entre cellule végétale et animale, comme le dit E. GUYENOT en 1950.

Après 1933, j'ai repris ces questions de l'influence du parasitisme dans mon livre 1944, p. 101 et 102 et je précise son influence sur les formes des micro-organismes par le texte que voici:

,,Ce facteur, représenté par l'hôte parasité ou, dans un degré beaucoup plus faible, par les milieux de nature animale, détermine chez le parasite une augmentation de la densité de protoplasma, un accroissement du nombre des noyaux, puis des produits de réserves, ainsi que des produits du métabolisme, excrétés par le protoplasma et localisés principalement sur les surfaces du parasite pour former ce que nous avons appelé ectoplasma.

Un parasite de nature végétale qui subit l'influence de ce régime épaissit ses enveloppes par l'accroissement de sa couche ectoplasmique et augmente la densité de son protoplasma. Ces deux changements réduisent la plasticité des formes et par conséquent leur grandeur et les rendent plus rigides, plus stables, plus régulières, comme celles de la cellule animale. C'est en somme une transformation adaptive que la cellule végétale subit sous un régime de nature animale.

„Aussi les parasites qui évoluent dans les tissus prennent des formes petites, régulières et arrondies comme celles de la cellule animale. Les spores régulières et arrondies des cheveux teigneux, les formes des protozoaires dans les tissus, les formes petites des bâtonnets acido-résistants du Bacille de Koch, les grains d'Actinomycès dans les lésions sont des formes rigides et régulières et indiquent la tendance adaptative de la cellule végétale vers la forme régulière de la cellule animale."

M. LANGERON, accepte également ma thèse de l'influence du parasitisme et en fait une loi qu'il appelle „Loi de réduction morphologique" et qu'il publie dans son livre 1946, p. 13 et 14, dans les mêmes termes et sous les titres Principes de Mycologie et Reduction morphologique et voici son texte:

„Cette réduction est particulièrement sensible chez les champignons parasites de l'homme et des animaux. Citons comme exemples: les dermatophytes ou champignons des teignes, qui présentent un contraste frappant entre l'état parasitaire arthrosporé et la riche morphologie de l'état saprophytique . . . ."

Enfin, M. LANGERON accepte également l'influence des milieux à base de cervelle que j'ai donné dans les Comptes Rendus de l'Académie des Sciences 1933, p. 61 et l'inscrit dans son livre 1946, p. 461, sans me citer.

Je voudrais ajouter ici quelques remarques sur les travaux publiés après la dernière guerre par MM. MONTGOMERY et des savants américains et qui ont attribué la formation des macroconidies des Dermatophytes à l'influence du parasitisme. Le Prof. BENEDEK a repris ce problème et ne paraît pas être d'accord avec l'interprétation de ces savants et, je partage son point de vue pour les raisons que voici:

Si la nutrition du parasitisme influence la structure cellulaire, ne peut s'exercer au point de modifier les caractères héréditaires. Les macroconidies se forment in vitro en très grand nombre et ces formes ne peuvent pas être l'effet du seul parasitisme, mais un retour aux caractères héréditaires de l'espèce. Il en serait autrement, si on pouvait fournir une preuve expérimentale en partant des formes pléomorphes, sans macroconidies, et en aboutissant à des formes qui produisent des macroconidies sous l'influence du parasitisme. Les expériences que j'ai fait dans ce sens ne sont pas démonstratives et méritent d'être reprises.

LES NOUVELLES DIAGNOSES DES GENRES ACHORION - MICROSPORON - EPIDERMOPHYTON - TRICHOPHYTON

Les quatre principes: 1°) Renversement de la loi de spécificité, 2°) Vieillissement des cultures, 3°) Sénescence et Pléomorphisme, 4°) Parasitisme, étant précisés, j'ai estimé que pour faire la diagnose d'un dermatophyte il ne faut tenir compte que des conidies des vieilles cultures et au stade où ces cultures ne sont pas modifiées par le pléomorphisme et autant que possible au stade de la culture originelle. Ce sont ces bases de cultures âgées et non pléomorphes, que j'appelle dans mon texte 1924 „Cultures mères âgées" qui m'ont permis d'introduire les quatre diagnoses: Macroconidies, Microconidies, Arthrospores et Vesiges de Sexualité et qui ont servi à toutes les classifications publiées en France entre 1923 et 1930. La seule innovation que LANGERON a faite en 1930, était de supprimer les Achorions, parce que dans les milieux naturels ces espèces se développent presque pas et c'est là une erreur mycologique et clinique à la fois.

On peut se servir de ces diagnoses pour donner une nouvelle diagnose aux vieux genres *Microsporon, Trichophyton, Achorion* et *Epidermophyton,* qui sont imposés par l'usage et ce qui peut concilier Dermatologistes et Mycologues. Ce sont ces genres et leurs diagnoses que je vais préciser maintenant.

Genre Achorion

(Diagnose: Arthrospores et cultures glabres)

Il suffit de laisser vieillir une culture d'*Achorion Schoenleinii* développée sur un milieu d'épreuve SABOURAUD, pour voir que le mycelium se dissocie en éléments irrégulièrement arrondis de 4—5 μ de diamètre et que j'ai appelé, en 1924, Arthrospores, et que ces formes étant placées dans de nouveaux milieux se gonflent et produisent 2 à 4 tubes germinatifs, et ce qui reproduit l'espèce. Ces Arthrospores sont riches en matière nucléoplasmatique, pleines de glycogène, avec plusieurs noyaux, et au cours de la germination produisent 2—4 filaments germinatifs et ce qui nous interdit de ne pas accorder de la valeur à ces arthrospores.

D'où viennent ces Arthrospores? Ce sont les cellules du mycelium qui dans le stade jeune sont accolées en chapelet comme les figure R. SABOURAUD au stade végétatif et qui se détachent avec le vieillissement des cultures et, ces cellules articulées deviennent des formes de reproduction et, c'est la raison pour laquelle, je les ai appelé en 1924, Arthrospores. R. SABOURAUD n'a pas pu préciser ces faits parce qu'il n'a pas laisser vieillir les cultures et LANGERON & OTA 1923, n'ont pas reconnu la valeur des Arthrospores, parce qu'ils travaillaient avec de faibles grossissements et n'ont jamais fait de cytologie avec de très forts grossissements ou laisser vieillir les cultures. Ces Arthrospores, dans les milieux naturels qui sont très pauvres, ne se développent pas.

Les cultures glabres des Achorions doivent former un genre autonome, ayant comme corps reproducteurs les Arthrospores, et sur lesquelles doit se baser la diagnose de ces espèces qui sont importantes, et différentes des autres Dermatophytes.

Ces cultures glabres peuvent se pléomorphiser in vitro, mais très lentement, parce que leur structure est plus influencée par le parasitisme, comme celle des Sporotrichées, et la cellule se nourrit difficilement à cause des membranes plus épaisses. Dans les milieux naturels, l'espèce ne pousse pas, sauf parfois, quelques filaments pléomorphes et dont les surfaces, étant plus minces, peuvent assimiler et se développer en filaments minces pléomorphes qui donnent des petites conidies, comme le font tous les filaments minces des Trichophytons, et ce qui a conduit M. LANGERON à confondre *Achorion* et *Trichophyton*.

Les Arthrospores que j'ai introduites avec le genre *Arthrosporia* pour les cultures glabres en 1924, et dont j'ai développé la cytologie en plusieurs pages en 1925, peuvent servir comme nouvelle diagnose de l'ancien genre *Achorion*. Le nom importe peu pourvu que la base de diagnose reste.

Les Achorions grouperont toutes les cultures glabres dont *Achorion Schoenleini*, l'ancien *Microsporon ferrugineum*, les anciens *Trichophytons faviformes*, ainsi que les *Endodermophytons* des mycoses exotiques décrites par CASTELLANI et qui se reproduisent également par Arthrospores et dont les cultures sont glabres. Toutes ces espèces, quand elles parasitent les poils, sont en principe endo-ectothrix et ce qui augmente leur ressemblance biologique. EMILE BODIN, qui a décrit premier les Trichophytons faviformes, les a groupé avec toutes les cultures glabres et, R. SABOURAUD les a placé à tort avec les Trichophytons. Ainsi toutes les espèces à cultures glabres qui se reproduisent par Arthrospores s'appeleront *Achorion* et cette diagnose est simple, facile et justifiée.

2ème Genre: Microsporon

(Diagnose: Macroconidies ou fuseaux)

Dans tous les livres classiques, y compris le livre de SABOURAUD, on trouve de figures de Macroconidies, mais on n'a jamais reconnu leur valeur, comme R. SABOURAUD l'a écrit dans les Annales de Dermatologie quelques années avant sa mort, parce qu'on examinait des cultures jeunes et où ces conidies n'étant pas développées, sont rares, puis mélangées aux filaments normaux et filaments pléomorphes et ce qui rend leur distinction difficile. OTA & LANGERON en 1923, disent pour leur genre *Sabouraudites* que les macroconidies — fuseaux, sont des formes végétatives sans valeur et n'ont tenu aucun compte pour leur classification 1923.

Seul le vieillissement des cultures non pléomorphes débarrasse l'espèce de toutes les formes mycéliennes et ne survivent que les Macroconidies — fuseaux en très grand nombre, et ce qui m'a permis de reconnaître l'importance des Macroconidies. Ces Macroconidies — fuseaux, sont tout à fait caractéristiques et très nombreuses dans les vieilles cultures et on peut, par leurs caractères différencier les espèces et ce qui m'a permis de voir que plusieurs espèces sont morphologiquement semblables, et ce qui a provoqué la réduction des espèces que, LANGERON et BRUMPT ont adopté également, sans me citer.

La Macroconidie est une forme de reproduction, car étant prélevée d'une vieille culture et étant placée dans un nouveau milieu d'épreuve, produit par germination, le mycelium et de ce fait est la base de la diagnose de ces espèces.

Les savants n'ont jamais fait figurer des germinations de Macroconidies, parce qu'ils n'ont pas ensemencé des Macroconidies de vieilles cultures, lesquelles donnent en 24 à 48 heures, 2—3 germinations très nettes. C'est aussi le seul moment où on peut colorer distinctement les noyaux et faire des recherches cytologiques, parce qu'après la phase germinative, la cellule se remplit de toutes sortes d'inclusions cytoplasmiques qui rendent l'analyse cytologique difficile et ce qui m'a fait échouer dans mes recherches cytologiques pendant de nombreuses années, malgré les conseils de mon Maître Cytologiste A. GUILLIERMOND, Professeur à la Sorbonne.

Toutes les espèces qui se reproduisent par macroconidies, je les ai réunies pour la Ière fois dans les Comptes Rendus de l'Académie des Sciences 1924, p. 1423, au genre *Closterosporia* (1924) avec comme diagnose, la macroconidie — fuseau.

Le Prof. VUILLEMIN (Janvier 1925) a présenté à cette même Académie, une autre classification dans laquelle a changé le nom *Closterosporia* en *Fusoma,* sans me citer et ce qui créait de la confusion. VUILLEMIN a mis deux heures pour fabriquer sa classification, tandis que j'ai travaillé six ans pour préciser ces diagnoses.

BRUMPT 1927, & LANGERON et MILOCHEVITCH 1930, sont allés plus loin encore. Ils ont pris la diagnose des macroconidies de mon genre *Closterosporia* 1924, et l'ont appliqué au genre *Sabouraudites* de la classification OTA & LANGERON 1923. Cette substitution a fait croire à tous les savants que les diagnoses de OTA & LANGERON 1923, ont la priorité sur mes diagnoses 1924, mais quand les savants les ont cherché dans cette classification 1923, ne les ont pas trouvé et mon travail 1924 est resté inconnu, parce qu'il n'était pas cité.

J'ai cherché avec le Prof. J. GUIART (1928) de rectifier ces erreurs et mettre fin à ces abus, mais il n'avait pas l'autorité nécessaire contre BRUMPT et LANGERON et moi-même je n'étais qu'un étudiant étranger sans aucune autorité.

Ceci étant, nous pouvons appliquer cette base des macroconidies 1924, au genre clinique *Microsporon* qui aura ainsi une valeur botanique parce que les macroconidies sont les corps reproducteurs les plus importants des Dermatophytes. Parmi les espèces qui feront partie de ce genre, on peut citer *Microsporon canis*, *Micros. lanosum*, *Micros. fulvum*, *Micros. gypseum* (ancien *Achorion gypseum*), *Micros. inguinale* (ancien *Epidermophyton inguinale*), *Micros. Audouini* [1]); etc. Les lésions de poils provoquées par ces espèces sont en général endo-ectothrix.

3ème Genre: Trichophyton

(Diagnose: Microconidies)

Les cultures des Trichophytons sont celles qui ont la moindre vitalité et ont le moins de virulence et déterminent en général le type endothrix, sauf bien entendu les espèces que j'élimine des Trichophytons, comme les *Trichophytons faviformes* et les *Tri. gypseum*, parce qu'ils sont cliniquement et mycologiquement différents.

Quand on laisse vieillir les cultures de *Trichophyton*, on trouve des microconidies peu nombreuses, de forme et de taille variable de 2 à 4 μ de diamètre environ. Ces microconidies prélevées sur les vieilles cultures ont en général 1 à 2 noyaux qu'on voit au stade de germination et ces conidies en germant sur nouveau milieu, en 24 heures, produisent un seul tube germinatif et ce qui indique leur faible vitalité.

On trouve parfois quelques rares macroconidies, souvent déformées et, ceci indique la parenté qui existe avec les Microsporons et que ces espèces correspondent à des formes récessives de ces espèces plus parfaites et plus vivaces et qui sont d'origine animale.

En 1924, j'ai séparé toutes ces variétés récessives d'espèces dégradées d'après la grandeur des microconidies en trois sous-genres, mais j'estime qu'on peut les grouper, pour simplifier, dans le genre *Trichophyton* qui prendra ainsi une diagnose mycologique précise, celle des microconidies qu'on trouve dans les cultures âgées et non pléomorphes.

On doit éliminer de ce genre, les *Trichophytons faviformes* qui ont de cultures glabres et rentrent dans le genre *Achorion* et les *Trichophytons gypseum* à cultures plâtreuses qui sont des espèces très différentes et que je classerai sous le nom d'*Epidermophyton*. On doit remarquer que les *Trichophytons faviformes* et les *Tr. gypseum* sont endo-ectothrix, tandis que les Trichophytons que je propose réunissent des endothrix, et ce qui justifie encore cette séparation.

4ème Genre: Epidermophyton

(Diagnose: Vestiges de Sexualité (périthèces et vrilles) Cultures plâtreuses, Microconidies par bourgeonnement)

Matruchot était Professeur de Botanique à la Sorbonne à Paris, et il a travaillé longtemps pour les champignons parasites avec son collaborateur DASSONVILLE. C'est à lui que nous devons la thèse de l'origine Gymnoascéenne des Dermatophytes, avec l'espèce *Eidamella Spinosa.*

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[1]) *M. Audouini*, a moins de macroconidies étant une forme dégradée du *M. canis* adaptée à l'homme.

C'est MATRUCHOT, qui après la guerre 1914—1918 m'a chargé de faire des recherches sur les Dermatophytes pour tâcher de trouver des formes qui permettent la diagnose botanique des Dermatophytes et notamment des formes sexuées, et ce que j'ai fait pendant cinq ans sans résultats.

La méthode que j'ai utilisé était l'emploi de divers milieux, parce qu'on croyait à ce principe de base et on faisait intervenir ce Dieu, comme Euripide le faisait pour ses tragédies, quand son drame se compliquait et qu'il ne pouvait plus s'en sortir. Ceci ne veut pas dire que je ne crois pas aux facteurs externes, mais leur action est indirecte et non directe sur le transformisme et elle est dictée par les possibilités biologiques cellulaires, dont le métabolisme est la cause directe. C'est ce que nous appelons aujourd'hui facteurs internes et que tout le monde a découvert, sauf moi.

En même temps, j'ai pris des Ascomycètes saprophytes, qui produisaient des périthèces vrais, pour mieux les connaître, et faire des comparaisons avec celles que j'espèrais trouver chez les Dermatophytes sous l'influence du milieu.

J'ai utilisé plusieurs milieux, y compris ce que LANGERON a appelé plus tard „naturels'' et que BROCQ, ROUSSEUX, URBAIN et BAROTTE, CATANEI ont utilisé également avant lui sans succès.

J'ai constaté alors que les Ascomycètes saprophytes que j'étudiais ont perdu, sous l'influence des milieux synthétiques, leurs périthèces et je ne voyais pas comment ces milieux favoriseraient la formation des périthèces chez les Dermatophytes.

MATRUCHOT a cherché longtemps à faire récupérer la sexualité des ascomycètes comme il le dit dans sa thèse de Sciences, il y a 60 ans, mais sans arriver et il l'a fait parce que nous croyions à la force du milieu. Cette même croyance a conduit LANGERON à écrire dans son livre pour ces milieux naturels, que les espèces assimilent mieux l'orge, le blé et l'amidon que le maltose et glycose, qui sont, dit-il, toxiques! Une erreur de base poussée au dogme mystique conduit toujours à l'aberration et nous fait perdre toute logique, comme disait GUSTAVE LE BON, au point que d'après LANGERON, il vaut mieux manger du blé que du sucre pour éviter le risque de s'empoisonner. Ce sont de tels dogmes qui ont permis d'appeler la tyranie, démocratie populaire.

Les Levures perdent à la longue leur sexualité en milieu synthétique, comme tous les champignons, et les cultivateurs de champignons de cultures, sont obligés de renouveler leurs spores, parce qu'elles deviennent impropres pour la reproduction du champignon à cause de la perte de leur vitalité.

Si les formes de sexualité existaient chez les Dermatophytes, il serait étonnant qu'on en trouve pas de traces dès les premières cultures et c'est alors qu'on pourrait les admettre dans le cadre d'une classification. Tout ce qui a été écrit à ce sujet, n'a pas été répété à ma connaissance, pour être admis sans hésitation.

Devant mes insuccës sur la formation de périthèces par les changements du milieu de culture, je me suis arrêté à certaines formes que présentent les *Trichophytons gypseum* et qu'on trouve d'une façon constante dans la culture. Ces formes ressemblent aux premières phases de formation d'un périthèce normal, ainsi qu'aux spirales ou vrilles qui se produisent dans les périthèces normaux, comme ornements de périthèces. J'ai assimilé ces formes à des vestiges de sexualité et comme on trouve ces vestiges constamment dans ces espèces, il est facile, même pour un médecin, de faire leur diagnose. Ces espèces sont d'ailleurs tout à fait particulières, et aucune autre espèce ne leur ressemble. Ce sont les anciens *Trichophytons gypseum* de SABAURAUD, à cultures plâtreuses et que j'ai séparé des autres Trichophytons en 1924, sous le nom de: genre *Spirallia* (spires ou vrilles).

BRUMPT (1927) et LANGERON & MILOCHEVITCH (1930) ont adopté ma thèse après l'avoir critiquée, dans les Annales de Parasitologie 1926, mais ils ont changé le nom du genre *Spirallia* (1924) en *Ctenomyces*, mais sans jamais parler de mon travail et le genre *Ctenomyces* (1930) a remplacé la diagnose de mon genre *Spirallia* 1924, malgré les lois de nomenclature et malgré que le genre *Ctenomyces* ne comprend que des périthèces parfaits, et ce qui n'existe pas ici. Cette substitution n'est donc justifiée, ni par les lois de nomenclature, ni par les caractères de ces espèces, mais le but de ceux qui l'ont créé n'était que d'imposer une classification portant leur nom.

Je crois qu'on pourait aujourd'hui appliquer cette diagnose de périthèces avortés et de vrilles de mon genre *Spirallia* 1924, au genre clinique *Epidermophyton*. Celui-ci n'a pas de raison d'être, parce que les espèces connues comme *Epidermophyton* se reproduisent surtout par macroconidies et doivent rentrer dans le genre *Microsporon*. On peut alors classer dorénavant comme *Epidermophyton*, les espèces dont la diagnose mycologique seront les vrilles et les périthèces avortés assimilés à des vestiges de sexualité. Enfin, les anciens *Trichophytons gypseum* sont endo-ectothrix et ont de plus la particularité de produire un nombre énorme de microconidies, de volume égal et dont la formation se fait par bourgeonnement comme chez les Levures et certains Mucoracées et non par rétraction et désintégration des filaments, comme les microconidies des Trichophytons et qui sont peu nombreuses et irrégulières. C'est là aussi des raisons valables pour les rendre autonomes et les separer de ce que j'ai classé comme Trichophytons.

Par la suite, on pourra considérer comme *Epidermophyton* toutes les espèces que les savants trouvent avec des formes sexuées et que POLLACCI, NANNIZI puis CONANT et ses collaborateurs disent avoir obtenu.

CONCLUSIONS.

Les classifications (OTA & LANGERON 1923, GRIGORAKI 1924, VUILLEMIN 1925, BRUMPT 1927, GUIART & GRIGORAKI 1928, LANGERON & MILOCHEVITCH 1930), ont utilisé les bases que j'ai donné dans les Comptes Rendus de l'Académie des Sciences 1924, p. 1423, avec des noms différents. Ces bases sont les suivantes:

1° Utiliser les milieux d'épreuve de SABOURAUD, comme milieu standard pour le développement des Dermatophytes et de leur diagnose.

2°) Laisser vieillir les cultures, parce que c'est au cours du vieillissement que les filaments disparaissent et les corps reproducteurs conidies, avec leurs caractères complets, survivent seuls en grand nombre et ce qui permet une diagnose facile de l'espèce.

3°) Utiliser des cultures originelles ou non pléomorphes, parce que l'espèce subit sous l'influence du pléomorphisme, une altération dans sa structure, causée par le métabolisme et, ce qui modifie les formes et les fonctions de l'espèce et aboutit à leur monomorphisme progressif.

4°) Les corps reproducteurs conidies qu'on trouve dans les vieilles cultures non pléomorphes est la seule base rationnelle d'une classification. Ces conidies sont de quatre formes: a) Les macroconidies; b) Les microconidies; c) Les arthrospores; d) Les vestiges de sexualité (périthèces avortés et de vrilles).

5°) Ces formes de reproduction étant appliquées aux anciens genres cliniques *Microsporon*, *Achorion*, *Trichophytov* et *Epidermophyton*, établissent les nouvelles diagnoses que voici:

Classification Sabouraud 1894, Emend. Grigoraki 1924

— *Microsporon* — Diagnose macronidies. Espèce Type *Micros. canis.*

— *Achorion* — Diagnose arthrospores et cultures glabres; (les Trichophytons faviformes, Micros. ferrugieum, etc., et toutes les cultures glabres en feront partie). Espèce Type *Achorion Schoenleinii*

— *Trichophyton* — Diagnose Microconidies, ces espèces sont en général de faible vitalité et endothrix. Espèce Type: *Trich. Crateriformes.*

— *Epidermophyton* — Diagnose Vestiges de sexualité (vrilles et périthèces avortés); reproduction par des petites conidies de grandeur égale qui se reproduisent par bourgeonnement en très grand nombre et ce qui rend ces cultures plâtreuses.

Espèce Type *Epidermophyton asteroides* (ancien *Trich. asteroides*) (Les anciens Epidermophytons étant donné leur reproduction par Macroconidies, deviendront des *Microsporon*).

6°) Les Dermatologistes doivent tenir compte que la loi de spécificité 1894, d''après laquelle le type de la lésion donnait son nom à l'espèce n'est pas absolue, parce que des parasites différents peuvent causer le même type de lésion et pour faire la diagnose de l'espèce, il faut l'établir d'après ses caractères mycologiques exposés plus haut.

On peut néanmoins distinguer pour un pays comme la France, quatre types cliniques: 1°) Le godet favique avec *Achorion.* 2°) Les Teignes endo-ectothrix avec *Microsporon.* 3°) Les Teignes endothrix avec *Trichophyton.* 4°) Les Sycosis de la barbe avec *Epidermophyton* (ancien *Tr. gypseum*).

Les variations à ces règles cliniques se produisent surtout chez des races et pays différents et ce qui nous impose la diagnose de l'espèce d' après sa culture et non sa lésion.

Je crois que ces bases peuvent satisfaire le Dermatologiste et sans que le Mycologue puisse évoquer des différences valables.

Résumé

Pour toutes les classifications introduites entre 1923 et 1930, y compris le genre *Sabouraudides* de la classification OTA & LANGERON 1923, nous avons utilisé comme diagnoses celles que j'ai donné en 1924.

Ces mêmes diagnoses peuvent être appliquées aux anciens genres cliniques *Achorion*, *Microsporon*, *Trichophyton* et *Epidermophyton*, que les Dermatologistes préfèrent. Ces genres auront de ce fait une valeur mycologique basée sur les formes de reproduction des espèces et, ce que les Mycologues ne sauraient valablement contester. Nous pouvons ainsi adopter une seule classification sans préjudice pour le progrès de la Mycologie et qui sera en même temps accepté par les Dermatologistes que les nouveaux noms créés par les diverses classifications ont choqué et cet avis a été soutenu déjà par le Prof. BENEDEK.

Note

Si la diagnose des genres est acquise, celle des espèces restera à faire d'après les caractères macroscopiques des cultures et surtout d'après les caractères biologiques des espèces. J'ai donné sur ces caractères biologiques une première description à la Société de Biologie 1921, et au Bulletin de la Société de Mycologie 1922, puis diverses publications publiées avec le Prof. DAVID entre 1934 et 1939. (Voir bibliographie dans le texte publié à Mycopathologia en 1956).

Ce sont ces mêmes bases que LANGERON a repris en 1938 et 1939 et qu'il développe dans son livre 1946, dans un chapitre spécial qu'il appelle ,,Zymologie'', mais sans mentionner mes textes. De nouvelles recherches sont nécessaires pour compléter ces caractères d'après des cultures non pléomorphes, parce que le pléomorphisme modifie les caractères biologiques au même titre que les caractères morphologiques.

Si les enzymes des champignons parasites non pléomorphes peuvent par la fermentation des sucres différencier les espèces, par contre, une classification basée sur des caractères purement immunologiques, comme le propose le professeur japonais KASUKE ITO M. D. (Mycopathologia 15-3-1958) me paraît difficile à cause de la faiblesse, de l'instabilité et de la parenté antigénique de ces parasites et par conséquent des anticorps correspondants.

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ON FACTORS INFLUENCING FRUIT-SET AND STERILITY IN ARECANUT

(*Areca Catechu Linn.*)

III. On possible influence of air spora on the normal course of pollination and fertilisation

by

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(28.XI.1958)

Introduction

Field studies on the arecanut palms (*Areca catechu* Linn.) under cultivation in the different parts of Assam have indicated that there is considerable extent of sterility of female flowers resulting in low yield of fruits, the loss of fruits due to sterility amounting to nearly 55 %. The failure of the female flowers to set fruits is attributed mainly to the failure of pollination and/or if pollinated, failure of fertilisation, the latter being due to failures of the pollen tubes to reach the ovules. The growth of the pollen tube inside the stylar canal is a complex phenomenon involving several morphological and physiological factors and from an analysis of the pollen cultures *in vitro* and of pollen grains germinating *in situ* in a large number of fallen flowers, it is observed that sterility may be due to (i) failure of the pollen tubes to reach the ovules, (ii) medium of the stylar canal failing to promote optimum growth of the pollen tubes and (iii) bursting of the pollen tubes inside the stylar canal and other physiological abnormalities (Raghavan & Baruah, 1956a). Studies on the growth of the pollen tubes have also indicated that pollen germination and pollen tube growth can be stimulated *in vitro* to a considerable extent by the use of certain synthetic auxins, vitamins and trace elements, but in no instance is the effect comparable to that possibly occurring normally *in vivo* (Raghavan & Baruah, 1956b).

During the course of further examination of the female flowers, it has, however, become evident that stigmas which are exposed and sticky, are liable to be impacted upon by the air spora together with the pollen grains in the plantations. The deposition of the spores and pollen grains together with carbon particles is, of course, influenced by the wind velocity, temperature, humidity, rainfall, sedimentation under gravity, edge drift, turbulence etc. (Bernstein & Feinberg, 1942; Sutton, 1949; Hyde, 1950; Gregory & Hirst, 1957; Ingold, 1953). The germination and subsequent growth of the alien organisms on the stigmas may thus affect in such instances the normal course of events leading to the fertilisation of the ovule and development of the fruit. Investigations described below, therefore, concern determination of air spora in arecanut plantations and their possible influence, *in vitro*, on the germination of pollen grains and growth of the pollen tubes.

Material and Methods

The methods used in order to determine the presence of air spora included (i) exposure of smeared slides fixed on to kites, in the atmosphere for a given period, (ii) exposure of nutrient plates in the arecanut plantations for different periods. Slides smeared with vaseline were exposed in the arecanut plantations at height of 50—70 feet where the inflorescences are attached to the palms. Traces of deposits on the slides were mounted in 'solva' and the number of different types of the spores occurring per unit area (5.0 × 5.2 cm.) was calculated by scanning successive traverses on the slide; results given are the average of eight slides exposed at the rate of two per week for May and June, 1957 between 10—11 a.m., determinations being made in six plantations. The frequency of occurrence of the culturable types of organisms was also obtained by exposing nutrient agar plates (2 % Malt extract agar) near the inflorescence for varying periods of time. The plates were subsequently incubated at 25° C and the average number of colonies of the different types was counted.

The determination of the presence of fungi, bacteria and actinomycetes on the stigmas of arecanut flowers was also made according to the following methods:

Stigmas of 50 open flowers were collected and transferred to sterile water. The sterile water containing the stigma washing was transferred to a 2 % Malt extract medium. By dilution plate technique, the number of organisms present was estimated. Five replicates were maintained in each case.

The histological method used was by cutting tangential and transverse sections of the stigmas and staining with Orange G and Thionin blue.

For germination studies of the pollen grains, the method followed was the same as described previously by RAGHAVAN & BARUAH, 1955.

Experimental

The problem whether fungal spores are present on the stigmatic surfaces of female flowers of areca palm was investigated first by histological method. Figs. 1 & 2 show the presence of fungal spores and pollen grains on the stigmatic surfaces. Cultural methods were adopted to determine the number of spores of fungi, actinomycetes or bacteria on the stigmatic surfaces of arecanuts.

Fig. 1 shows the number of colonies of fungi, bacteria and actinomycetes in culture. It is seen that spores of *Aspergillus, Penicillium, Actinomycetes* and *Bacteria* are the types principally associated with the stigmas of open flowers of arecanut. The medium (2.0 % Malt extract) was diluted to nearly one millionth time and the number of colonies of the particular organisms present was counted. (Fig. 3)

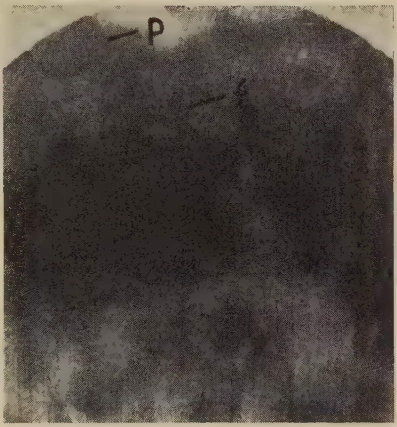

Fig. 1. Section of the stigma showing growth of fungal hyphae (× 50).
Fig. 2. Section of stigma showing pollen grains (P) and fungal spores (F) (× 100).

In order to determine the presence of air spora, smeared slides were exposed in the arecanut plantations. Traces of deposit on the slide were mounted in 'solva' and the number of different types of spores and pollen grains impacted during one hour per unit area was counted (Table I).

TABLE I.

Number of fungal spores and pollen grains impacted on sticky slides (5.0 × 2.5 cm *area*) *exposed for* 1 *hour in the arecanut plantation.*

No. of gardens.	*Areca* pollen	Other angiosp. pollen	*Mucor*	*Penicillium*	*Aspergillus*	*Cladosporium*	*Actinomycetes*	Rust Uredo spores	*Alternaria*	Other fungal spores
1	110	400	1900	6300	5300	800	1300	110	100	—
2	330	300	2300	8100	8500	1200	2200	—	—	—
3	—	500	1100	4900	5600	1300	2400	220	100	—
4	110	700	1200	3000	1400	1400	2000	—	300	—
5	110	400	1400	5300	3100	1300	2200	100	100	—
6	—	300	3000	2000	2300	880	1300	—	—	—

It appears that there is a mixed air spora together with pollen grains in the atmosphere, the number of which varies according to wind velocity, temperature, humidity, turbulence and probably other factors (SUTTON, 1949). The other method of exposing nutrient plates at heights of the inflorescence axis of the palm in the arecanut plantations also shows the presence of *Alternaria*, *Aspergillus*, *Penicillium*, *Mucor* and *Actinomycetes* (Table II). By exposing for longer periods there is marked increase in the number of colonies of fungi, bacteria and actinomycetes.

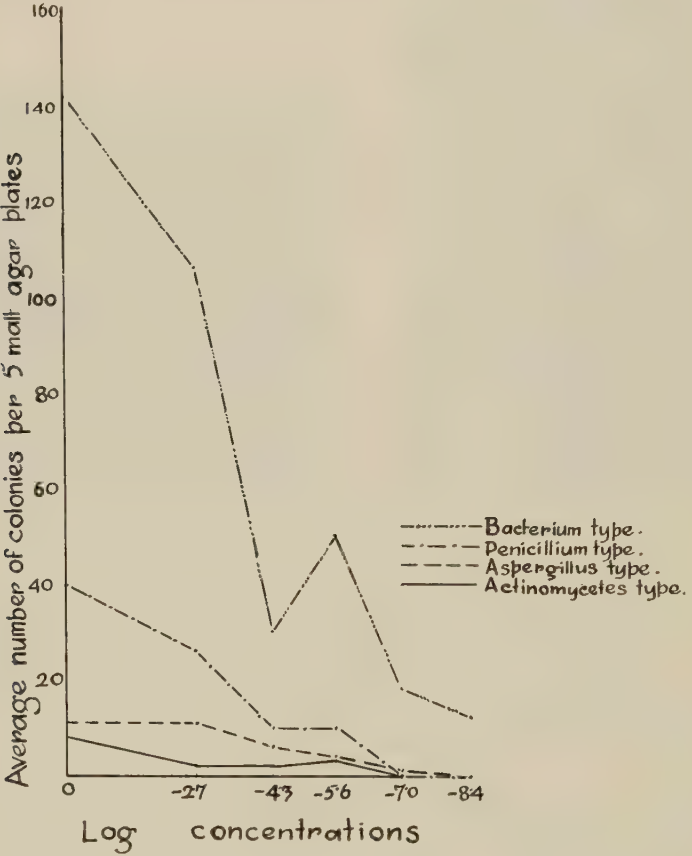

Fig. 3. Effect of dilution of medium on the number of colonies.

It is thus apparent that stigmas of the female flowers of arecanut palms are exposed to an atmosphere rich in pollen grains, spores of fungi, bacteria and actinomycetes. It is possible that the spores may germinate on the stigmatic surface and secrete substances which may inhibit or promote the extent of germination of the pollen grains and the rate of elongation of the pollen tubes inside the stylar canal. This aspect is further investigated experimentally by determining the germination potential of pollen grains of arecanut and the rate of elongation of pollen tubes *in vitro* in nutrient solutions and stigma extracts to which a wide range of concentrations of media on which fungi and actinomycetes have grown, are added. *Aspergillus*, *Penicillium*, *Bacterium* sps. and *Actinomycetes* were grown on Czapek Dox medium and the cultures were incubated at 28—30° C for 9 days. The media were then filtered through Seitz filter and the culture fluid of each of the respective fungi, *Bacterium* sps. and *Actinomycetes* sps. was used for experimental purposes. Pollen grains were sown in a series of distilled water, 0.5 % sucrose, 2.0 % stigma extract and 2.0 % stigma extract + 0.5 % sucrose media to which 0.1, 0.5, 1.0, 5.0, 10.0, 50.0, 100 cc. of the culture fluid were added (Table III). Controls were set up by adding the different concentrations of Czapek Dox media without growing the respective fungi, bacteria or actinomycetes to the media on which pollen grains have been sown. It is seen that the addition of fungal or bacterial filtrates to the medium inhibits considerably the germination of pollen grains and growth of pollen tubes, the extent of inhibition varying with the nature of the filtrate and the concentration used. Generally *Aspergillus* and *Penicillium* filtrates exercised greater inhibitory action than bacterial and actinomycetes extracts, addition of 10—50cc. of filtrate per 100 cc. of nutrient solution being sufficient for complete inhibition of the germination of pollen grains. The action of *Actinomycetes* extract was not marked, where as the bacterial extract exhibited the least inhibition. In all cases, greater extent of pollen germination and pollen tube growth was obtained in the control.

TABLE II.

Number of colonies of fungal and bacterial organisms on exposed nutrient plates.

Types	Nutrient plates exposed for					
	0	5 sec.	10 sec.	30 sec.	60 sec.	300 sec.
Alternaria	—	—	—	2	1	2
Aspergillus	—	—	2	1	—	5
Mucor	—	1	—	1	—	2
Penicillium.	—	—	—	1	3	1
Actinomycetes	—	α	α	α	α	α
Bacterium	—	38	α	α	α	α

The culture medium to which the metabolic fluid had been added also inhibited the growth of pollen tubes, resulting in the production of short pollen tubes (Fig. 5) or formation of vesicles (Fig. 6) or in failure of pollen grains to germinate in the first instance but later germinating in the medium (Fig. 7). It had not been possible to dialyse the metabolic fluid i.e. the media on which the organisms had been grown to ascertain whether the effects noted on the arecanut pollen grains are due to the toxins secreted

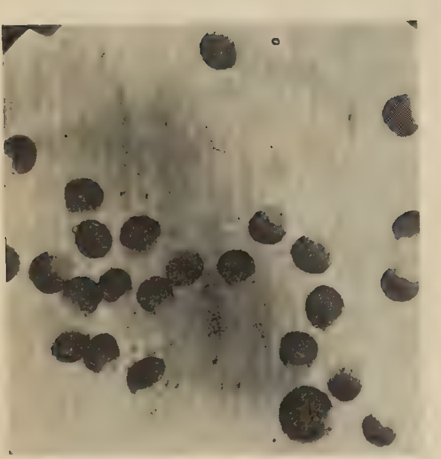

Fig. 4. Ungerminated pollen grains in concentrated extracts (x 100)

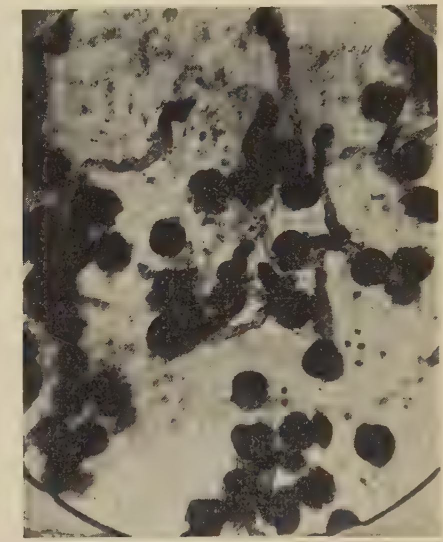

Fig. 5. Pollen germinating into short tubes (× 100).

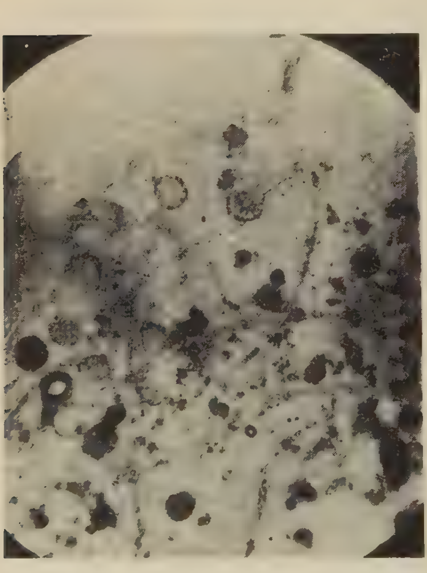

Fig. 6. Formation of vesicles at the tips of short tubes (× 100).

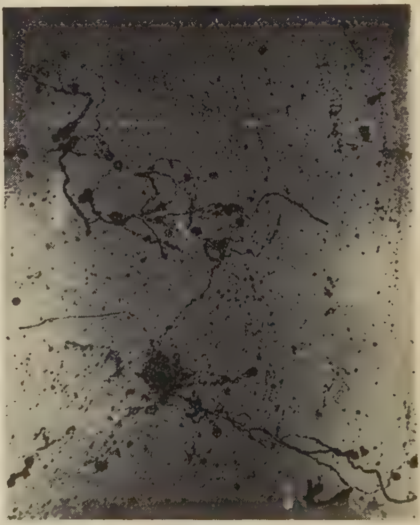

Fig. 7. A few longer pollen tubes formed in dilute extracts (× 50).

cc.s of filtrate/ 100 cc. of basic nutrient	Distilled water										0.5 % sucrose									
	Control*		*Aspergillus*		*Penicillium*		*Actinomycetes*		*Bacterium*		Control*		*Aspergillus*		*Penicillium*		*Actinomycetes*		*Bacterium*	
	%	μ	%	μ	%	μ	%	μ	%	μ	%	μ	%	μ	%	μ	%	μ	%	μ
0.1	50	300	25	102	20	120	32	120	40	200	60	500	25	480	54	278	52	428	50	280
0.5	48	220	20	80	20	86	32	98	40	220	60	360	25	325	50	200	52	320	42	220
1.0	48	200	20	82	20	88	31	80	34	186	65	350	25	100	25	220	50	229	25	238
5.0	48	120	—	—	18	62	30	80	34	96	48	220	10	80	10	120	50	28	10	25
10.0	40	118	—	—	—	—	—	—	30	102	48	84	—	—	10	45	50	20	5	10
50.0	35	120	—	—	—	—	—	—	—	—	48	120	—	—	—	—	5	10	1	5
100.0	32	120	—	—	—	—	—	—	—	—	32	100	—	—	—	—	5	5	1	5
Concentrated filtrate only	20	40	—	—	—	—	—	—	—	—	28	80	—	—	—	—	—	—	—	—
	2.0 % stigma extract										2.0 % stigma extract + 0.5 % sucrose									
	Control*		*Aspergillus*		*Penicillium*		*Actinomycetes*		*Bacterium*		Control*		*Aspergillus*		*Penicillium*		*Actinomycetes*		*Bacterium*	
	%	μ	%	μ	%	μ	%	μ	%	μ	%	μ	%	μ	%	μ	%	μ	%	μ
	48	280	25	120	35	210	40	200	34	210	60	480	25	100	50	300	30	200	48	280
	48	200	20	100	30	200	42	200	30	200	50	360	25	100	45	300	30	200	48	280
	40	200	22	100	30	200	34	180	30	180	40	200	25	100	20	200	25	220	30	220
	40	220	20	80	30	120	34	100	30	100	20	200	10	80	20	180	25	100	30	200
	20	122	20	80	10	90	34	100	30	26	20	100	—	—	10	100	—	—	30	100
	20	89	—	—	10	6	30	50	—	—	—	—	—	—	—	—	—	—	28	58
	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	22	56
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	20

* control = liquid medium only without the isolates being grown.

% = percentage of germination of pollen grains

μ = average length of pollen tubes in μ

in the media or due to the metabolicions of the salts used in the media. The culture fluid and the control media were, however, filtered through the Seitz filter and the effects noted generally were inhibitory to the germination of pollen grains and growth of pollen tubes.

Discussion and Conclusions

From the results of the present investigation, it is possible to determine quantitatively the extent of the presence of air spora together with pollen grains in the atmosphere. The stigmas of the female flower are not only exposed to receive pollen grains of their own specific types but also open to spores of fungi, bacteria and actinomycetes. The efficiency of the stigmatic surface in so far as it concerns the perpetuation of the reproductive phase is liable to be impaired if the specific pollen grains of its own type are in association with the spores of alien organisms. It has been experimentally proved that the organisms found on the stigmatic surface, when grown in culture, exhibit a marked antagonism or inhibition to the normal germination of pollen grains and their growth. The addition of even small concentrations of the culture fluid on which the fungi have grown, inhibits the extent of germination of pollen grains and rate of growth of pollen tubes. The cause of this inhibition of germination of pollen grains, in culture, is not properly understood but it is possible that this phenomenon together with the bursting of pollen and the related events happens under natural conditions of germination on the stigma. It has already been noted that the limits of the length of pollen tubes inside the stylar canal and successful germination of pollen grains on the stigma are important factors controlling successful fertilisation in the flowers. It has however, not been possible to study the influence of the air spora which are lodged on the stigmatic surface on the germination of the pollen grains and growth of the pollen tubes inside the stylar canal but the experiments *in vitro* indicate the nature of inhibition on the physiological activity of the pollen grains leading to sterility of female flowers in arecanut palms and the consequent loss in fruit-set. Evidence is given of the presence of hyphae in the stigma and it is thus possible that enzymes or toxins secreted during growth by fungi, bacteria and actinomycetes affect the normal phase of fertilisation. This observation hitherto not recorded may be of considerable interest in view of the importance of the probable role of the air spora such as fungi , bacteria and actinomycetes as antagonists in inducing flower fall and loss in fruit-set.

Summary

(1) Histological studies on the stigmas of female flowers of areca indicate the possibility of the stigmatic surfaces being impacted upon by air spora. The presence of spores or hyphae

together with pollen grains has been shown in stigmatic surface.

(2) Air spora of arecanut plantation chiefly consist of *Aspergillus*, *Penicillium*, *Actinomycetes*, *Mucor*, *Alternaria*, *Cladosporium* and *Bacteria*.

(3) The types of fungi, bacteria and actinomycetes adhering to the stigma are isolated.

(4) The metabolites of the fungi, bacteria and actinomycetes isolated from the stigmas of arecanut flowers inhibit, *in vitro*, considerably the germination of pollen grains and rate of growth of pollen tubes. In certain instances there is no germination of the pollen grains in the metabolites of fungi, bacteria and actinomycetes. In view of the results the significance of the air spora in affecting the normal course of pollination and fertilization is discussed.

Acknowledgement

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PHRAGMOSTILBE, A NEW GENUS OF THE STILBACEAE FROM NORTH AMERICA

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(13.XII.1958)

This paper presents observations on an interesting hyphomycete collected many years ago by the late Dr. D. H. Linder of the Harvard University and deposited at the Farlow Herbarium at Harvard, U.S.A. The fungus was found in material labelled "*Acrothecium album* Sumstine, on wet decayed maple, Milton, Mass., coll. and det. D. H. Linder, Nov. 1934." In the course of taxonomic studies on hyphomycetes, I had the opportunity to examine part of Linder's material ex National Fungus Collections, U. S. Department of Agriculture, through the courtesy of John A. Stevenson. A description of the fungus follows.

The fungus forms colonies consisting of scattered synnemata which are whitish and conspicuous. The synnemata are simple and up to 815 μ tall. The stalk of the synnema is simple, very pale brown in color, somewhat cylindrical but slightly broader towards the base than above, composed of simple, unbranched, hyaline, thin-walled, septate hyphae about 1—2 μ wide compactly clustered parallel to each other. The hyphae of the synnema become free at various levels on the stalk from its apex downwards to a length of about 400—500 μ and diverge from the stalk, so that a good portion of the stalk from the apex downwards appears sporiferous. The sporiferous part (i.e., the synnema together with the clusters of conidia) is 280—350 μ wide. The conidia appear to be produced acropleurogenously on conidiophores which are the unbranched free ends of the hyphae of the synnema. The conidiophores are simple and diverge from the stalk of the synnema; they are somewhat long-clavate towards their tips which are 1.4—4.2 μ wide and which alone are fertile. The conidia appear to be produced as follows. After the first conidium is produced at the tip of the conidiophore, growth of the conidiophore may be resumed laterally at a point immediately below the point of origin of the first conidium, and a second conidium may be produced. This process may be repeated and a succession of conidia may be produced in this way. Conidia may be produced pleurogenously also, but they are confined to the apical part of the conidiophore. Each conidium is borne on the conidiophore subtended by a narrow peg or stalk which is part of the conidiophore since it is not delimited from the conidiophore by a cross wall. This peg is about 1.5 μ wide and may be up to 7.0 μ long. The extent to which growth of conidiophore takes place between production of successive conidia varies. When the interval between production of successive condidia is short, a closely packed cluster of conidia results. Often, the conidiophore grows for a considerable length, often equal to the length of a spore (about 28—40 μ), before producing a second conidium or a second cluster of conidia. This process may be repeated; thus a conidiophore may have fertile "nodes" bearing clusters of conidia separated by sterile "internodes". These "internodes" are somewhat fusiform, being broadest in the middle and tapering towards either end. The conidia are hyaline, long, somewhat fusiform, thin-walled, 3-septate, smooth, with a somewhat inverted-truncate basal cell with a flat base about 1.5 μ wide, and an apical cell which is somewhat truncate and smoothly rounded at the tip. The conidia are produced singly and are not easily shed, being subtended by a peg which is part of the conidiophore; they are 28—40 μ long and 4.2—5.6 μ wide where they are widest.

I do not know if LINDER's determination refers to the fungus I have just described from his material ex Farlow Herbarium, kindly loaned by Mr. STEVENSON, although it is not unlikely that it does since the fungus produces phragmospores. A search through the literature did not enable me to trace the name, "*Acrothecium album* SUMSTINE"¹) in a publication. No description was available. However, in reply to my query, Mr. STEVENSON very kindly informed me that he had heard indirectly from Dr. SUMSTINE "that he (Dr. SUMSTINE) never formally published the name *Acrothecium album* and, consequently, the name is not valid".

The name *Acrothecium* has been discussed by MASON (1928) and by BOEDIJN (1933). As typified by *A. multisporum* PREUSS, the genus belongs to the Moniliales-Dematiaceae-Phragmosporae. In *A. multisporum* "the spores form a clump at the tip of the dark-colored conidiophore, they are narrow elliptical, are finally 1-, 2-, or 3-septate, and remain subhyaline" (MASON, 1928, P. 9). As may be seen from the description and illustrations given in this paper, LINDER's fungus forms distinct synnemata and it cannot, therefore, be placed in *Acrothecium* which has mononematous dark colored conidiophores. As far as I am aware, there is no genus of the Stilbaceae-Phragmosporae combining the features of LINDER's fungus and I am, therefore, proposing a new genus for it.

Phragmostilbe gen. nov.

Pertinet ad Fungos Imperfectos, ad Moniliales, Stilbaceas, Phragmosporas. Synnemata simplicia, pallide colorata, constantia e hyphis simplicibus, hyalinis vel subhyalinis. Conidia producta ad apices liberos hypharum synnematis (conidiophororum). Conidiophori divergentes ex synnemate ad altitudines varias per

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¹) The envelope containing the specimen ex National Fungus Collections, U.S.D.A. had the label, as already cited above, but the sheet carrying the envelope had the label "*Acrothecium album* WAKKER on *Acer* sp.". This latter citation is obviously a mistake.

totam partem sporiferam, hyalini, ut plurimum simplices. Conidia acro-pleurogena, elongata, hyalina, septata, producta singulariter, singula subtensa paxillo angusto. Conidia producta successive in uno eodemque conidiophoro per incrementum laterale renovatum conidiophori absque ullo ordine definito.

Fungus imperfectus, Moniliales, Stilbaceae, Phragmosporae. Synnemata simple, lightly colored, composed of simple, hyaline to subhyaline hyphae. Conidia produced on free ends of hyphae of synnema (conidiophores). Conidiophores diverging from synnema at various levels along its sporiferous part, hyaline, usually simple. Conidia acropleurogenous, elongate, hyaline, septate, produced singly, each subtended by a narrow peg. Conidia produced successively on same conidiophore by renewed lateral growth of conidiophore without definite order.

Type species:

Phragmostilbe linderi sp. nov.

Coloniae constantes e synnematibus dispersis. Synnemata simplicia, albida, usque ad 815 μ alta, constantia e stipite atque parte superiore sporifera. Stipes synnematis simplex, pallide brunneus, nonnihil cylindricus sed tenuiter latior ad basim quam supra, constans e hyphis simplicibus, hyalinis, tenuibus parietibus praeditis, compacte aggregatis parallelis inter se. Pars sporifera synnematis 400—500 μ alta, 280—350 μ lata. Conidia producta ad apices liberos hypharum synnematis (i.e. conidiophororum). Conidiophori divergentes e synnemate ad altitudines varias in parte sporifera, simplices, hyalini. longe clavati, undulati ad apicem fertilem, 1.4—4.2 μ lati. Conidia subtensa paxillo angusto (qui tamen e conidiophoro non surgit nec partem ullam illius efformat); paxillus ca. 1.5 μ latus, usque ad 7.0 μ longus. Conidia producta acro-pleurogene atque singulariter in conidiophoro, elongato-fusiformia, latissima ad medium, hyalina, tenuibus parietibus praedita, levia, 3-septata, 28—40 μ longa, 4.2—5.6 μ lata ad partem latiorom; cellula basalis conidii inverso-truncata, basi plana ca. 1.5 μ lata, cellula apicalis aliquantum truncata atque leviter rotundata ad apicem. Conidia producta successive in uno eodemque conidiophoro per incrementum renovatum conidiophori lateraliter absque ullo ordine definito; incrementum renovatum saepe ducit ad elongationem conidiophori, quam sequitur productio conidiorum; exitus tandem est formatio "internodorum" sterilium et "nodorum" fertilium, fasciculis conidiorum unicuique nodo insidentibus.

Typus lectus in *Acere* quodam madido putrefacto ad Milton in Statu Massachussets, in Statibus Foederatis Americae Borealis a D. H. LINDER, mense novembri anni 1934 ex Farlow Herbario, in Universitate Harvard, ex Collectione Nationali Fungorum, U.S.D.A. et positus in Herb. MUBL sub numero 1726.

Colonies composed of scattered synnemata. Synnemata simple, whitish, up to 815 μ tall, consisting of a stalk and upper sporiferous

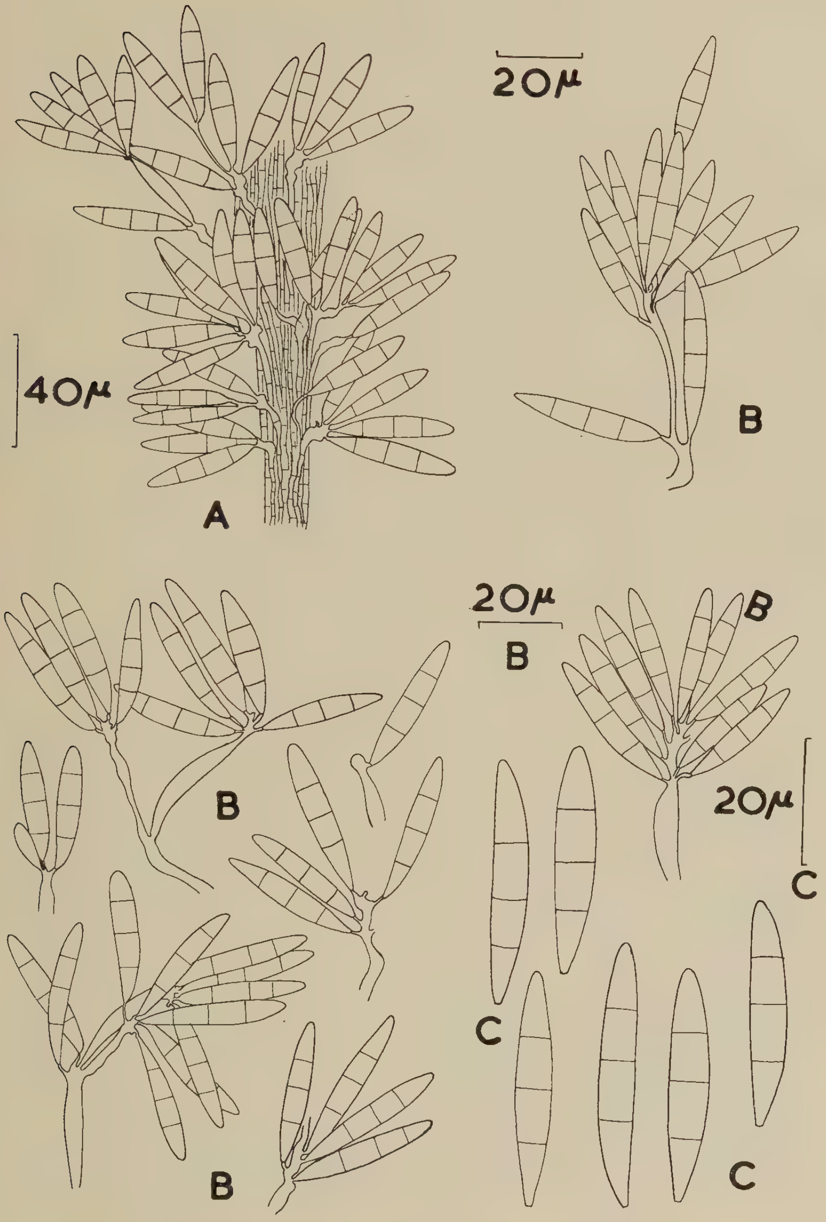
20μ
40μ
A
B
20μ
B
B
20μ
B
B
C
C
C
B

Fig. 1. *Phragmostilbe linderi* from type specimen, Herb. MUBL 1726. A, part of synnema; B. conidiophores showing conidial development and conidial clusters; C, conidia.

part. Stalk of synnema simple, pale brown in color, somewhat cylindrical but slightly broader towards the base than above, composed of simple, hyaline, thin- walled septate hyphae compactly clustered parallel to each other. Sporiferous part of synnema 400—500 μ tall, 280—350 μ wide. Conidia produced on the free ends of hyphae (conidiophores) of the synnema. Conidiophores diverging from synnema at various levels in the sporiferous part, simple, hyaline, long-clavate, wavy towards the fertile tip, 1.4—4.2 μ wide. Conidia subtended by a narrow peg (which is not cut off from the conidiophore and is part of it); peg about 1.5 μ wide, up to 7.0 μ long. Conidia produced acropleurogenously and singly on the conidiophore, elongate-fusiform, widest about the middle, hyaline, thin-walled, smooth, 3-septate, 28—40 μ long, 4.2—5.6 μ wide where widest; basal cell of conidium inverted-truncate with a flat base about 1.5 μ wide, apical cell somewhat truncate and smoothly rounded at tip. Conidia produced successively on same conidiophore by renewed growth of conidiophore laterally without any definite order; renewed growth often leading to elongation of conidiophore followed by conidial production, resulting in sterile "internodes" and fertile "nodes" bearing clusters of conidia.

Type specimen: on wet decayed maple (*Acer* sp.), Milton, Mass., U.S.A., coll. D. H. LINDER, November 1934, ex Farlow Herbarium, Harvard University, ex National Fungus Collections, U.S.D.A. (Herb. MUBL 1726 — slide).

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ASPECTOS CLÍNICOS E EPIDEMIOLÓGICOS DAS MICOSES PROFUNDAS NA AMÉRICA DO SUL [1]

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As micoses profundas ocorrem com relativa freqüência na América do Sul. Apenas a mucormicose e as micoses por cogumelos dos gêneros *Basidiobolus* e *Cercospora* ainda não foram assinaladas nesta parte do continente americano. Em contraposição, duas micoses são peculiares ao território sul-americano: a blastomicose sul-americana e a blastomicose queloideana ou "blastomicose tipo Jorge Lôbo". Esta última infecção micótica foi particularmente descrita nos seringueiros da Amazônia, bem como entre indígenas do Brasil Central, sendo no entanto, de distribuição muito limitada.

Para que se possa analisar os aspectos epidemiológicos mais importantes das micoses profundas na América do Sul, procuraremos descrever, de modo resumido, a sua geografia regional, orientando-nos por elementos colhidos em alguns textos de geografia, de autoria de Aroldo de Azevedo.

Dada a limitação de tempo para a nossa exposição, procuraremos focalizar apenas os aspectos que julgamos mais importantes no que diz respeito à ocorrência das micoses profundas no continente sul-americano.

Tanto a estrutura física como a vida humana do continente sul-americano explicam a relativa simplicidade de sua geografia regional (Aroldo de Azevedo).

De fato, torna-se possível reconhecer, pelo menos, as seguintes regiões geográficas: 1) a região dos Andes; 2) a região do Orenoco e das Guianas; 3) a Amazônia; 4) o nordeste brasileiro; 5) a região do São Francisco e o litoral oriental do Brasil; 6) o planalto Central brasileiro; 7) o sul do Brasil; 8) a região Platina e a Patagônia.

A região dos Andes, em contato com as águas do Pacífico, ocupa tôda a porção ocidental da América do Sul. Como elemento característico de sua paisagem, apresenta a Cordilheira dos Andes, numa extensão de 6.000 Km, oferecendo muitos contrastes quanto ao clima e paisagens botânicas.

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[1]) Relatório apresentado aos Sextos Congressos Internacionais de Medicina Tropical e de Paludismo, realizado em Lisboa, de 5 a 13 de setembro de 1958.

Assim, consideram-se os Andes equatoriais úmidos, mais regados pelas chuvas; os Andes tropicais sêcos, em algumas regiões com verdadeiros desertos e os Andes glaciais, com chuvas abundantes e baixa temperatura. Suas terras pertencem a sete países: Venezuela, Colômbia, Equador, Perú, Chile e Argentina.

A região do Orenoco e das Guianas corresponde à porção setentrional do continente, onde dois elementos fisiográficos bem a definem: a planície do Orenoco e o planalto das Guianas. Clima quente e úmido caracteriza esta região. Três países americanos — Colômbia, Venezuela e Brasil, e três países europeus — Grã-Bretanha, Holanda e França dominam as regiões do Orenoco e das Guianas.

A Amazônia (planície Amazônica) dominada por um clima quente e superúmido e pela imensa "Hyloea", (denominação dada por HUMBOLDT à floresta amazônica), uma das mais vastas áreas florestais da terra, é ecassamente povoada, por indígenas e mestiços, devendo-se destacar como uma de suas mais importantes riquezas, a borracha extraída das seringueiras. Sete milhõse de Km^2, do território da América do Sul, vêem-se banhados pelas águas do Rio Amazonas e de seus inúmeros tributários. A maior parte da Amazônia pertence ao Brasil, mas outros países sul-americanos também possuem parcelas desta área regional: Colômbia, Perú e Bolívia.

O Nordeste brasileiro, situado entre o Vale do Parnaíba e o vale médio inferior do São Francisco, apresenta clima quente semi-árido, com chuvas escassas e mal distribuídas. Em sua porção oriental, próxima do Atlântico, encontra-se clima quente e úmido, ao qual correspondia autrora uma faixa de florestas. Daí a distinção que costuma ser feita entre o Sertão e a Zona da Mata.

A região do São Francisco e o litoral oriental do Brasil apresenta clima quente, embora ameno nas áreas montanhosas. Grandes extensões de campos e a Mata Atlântica caracterizam a vegetação regional.

O Planalto Central Brasileiro, que é o trecho central do continente, apresenta clima quente, semi-úmido, com vegetação de campos, contendo as cabeceiras de rios pertencentes às três maiores bacias sul-americanas (Amazônica, Platina e do São Francisco).

O Sul do Brasil, cujas terras são drenadas pelos rios Paraná e Uruguai, tem um clima subtropical, com chuvas regularmente distribuídas durante o ano.

A região Platina e a Patagônia é limitada a oeste pelos Andes e al leste pelo Sul do Brasil e as águas do Atlântico. Na região Platina é possível distinguir: a) o Chaco, com seu clima subtropical e florestas descontínuas; b) o Pantanal matogrossense, com terras inundáveis; c) o Pampa, com seu clima temperado, domínio das formações estépicas; a vegetação rasteira é dominante. No extremo sul, a Patagônia, com seus planaltos de clima rude (frio e desértico) e sua escassa vegetação. Cinco países possuem as terras dessa região: Argentina, Uruguai, Paraguai, Bolívia (Chaco) e Brasil (Pantanal).

Vemos, portanto, que os climas quentes dominam em vasta área do continente sul-americano (planalto das Guianas, planície Amazônica e maior parte do Planalto brasileiro). Os climas subtropicais correspondem à depressão do Paraguai e ao sul do Planalto brasileiro; os climas temperados, à região dos Andes e ao Pampa; os climas frios, aos Andes meridionais e os climas desérticos à grande parte da costa do Pacífico e à Patagônia.

A América do Sul possui cêrca de 90 milhões de habitantes, o que dá 5 habitantes por Km^2, cifra realmente muito baixa. Tal população acha-se espalhada de forma muito desigual, geralmente junto ao litoral.

O Brasil, colocado na porção centro-oriental do continente sul-americano, possui uma área de 8.511.000 Km^2; estende-se desde as regiões cortadas pelo Equador (que passa exatamente na embocadura do Rio Amazonas) até bem ao sul do Trópico do Capricórnio (que corta a cidade de São Paulo). Colocado em sua maior parte na zona tropical, o Brasil acha-se voltado para o Atlântico Sul, a cuja vida muitos laços o prendem estreitamente.

Blastomicose sul-americana

Passando ao estudo clínico e micológico das micoses profundas que ocorrem na América do Sul, devemos destacar pela sua importância médico-social, a blastomicose sul-americana ou ,,doença de Lutz-Splendore-Almeida''. Esta infecção, de decurso geralmente grave, provocada pelo *Paracoccidioides brasiliensis*, já foi assinalada em quase todos os países da América do Sul. Os únicos dois casos registrados fora do continente sul-americano — um nos Estados Unidos (PERRY & colab., 1954) e o outro, na Itália (publicação de MOLESE & colab., 1957) referem-se a pacientes procedentes da Venezuela, onde a doença existe endêmicamente. Tal infecção ocorre também na América Central, pois em Costa Rica, TREJOS & ROMERO (1953) assinalaram 3 casos.

Em 1955—1956 fizemos sôbre a blastomicose sul-americana estudo de conjunto, analisando os principais dados referentes à sua história, distribuição geográfica, aspectos micológicos, fontes de infecção, formas anátomo-clínicas, diagnóstico diferencial, diagnóstico de laboratório, anatomia patológica, tratamento e contrôle de cura.

Até junho deste ano, haviam sido fichados na Secção de Micologia da Faculdade de Medicina casos de blastomicose sul-americana, a maioria atingindo trabalhadores rurais, entre as idades de 30 e 50 anos.

Dos países da América do Sul, apenas no Chile ainda não se registraram casos desta micose, segundo AGUIRRE (1957). Êste pesquisador refere, também, que um inquérito realizado no Chile, em 1952, por HONORATO & CRUZ PLAZA, com paracoccidioidina, em 137 escolares do Vale de Colliguay (Província de Valparaíso), resultou absolutamente negativo. Fato digno de menção é a frequência com que os imigrantes japonêses, no Brasil, são vítimas da blastomicose. Dedicando-se à lavoura, pagam maior tributo à referida infecção que, muitas vêzes, em tais pacientes, se manifesta com quadros clínicos bastante graves. Em 1957, na Argentina, NEGRONI assinalava 30 casos de blastomicose, sendo que a zona mais intensamente infectada é a do Chaco. Para NEGRONI (1951) a blastomicose sul-americana apresenta longo período de incubação e os casos aparentemente autóctones de outras zonas do país, adquiriram a infecção em regiões onde a referida micose é endêmica.

FLOCH (1958) registrou, também, no extremo norte do continente, na Guiana Francêsa, um caso desta infecção. Em 1956 RUBIO, no Perú, descrevia de 1937 a 1955, 18 casos de blastomicose sul-americana.

A experiência dos pesquisadores brasileiros com a blastomicose sul-americana é grande, tendo sido a referida infecção observada pela primeira vez em São Paulo, em 1908, por ADOLFO LUTZ. Ressaltem-se as valiosas contribuições de SPLENDORE (1912) e principalmente de ALMEIDA (1933) no estudo desta infecção, endêmica no Brasil e de indiscutível importância médica e social.

Durante muito tempo o agente da blastomicose sul-americana foi confundido com o *Coccidioides immitis*, tendo ALMEIDA (1933) mostrado, em numerosos trabalhos, as diferenças entre êsses dois parasitas, a custa de elementos de diferenciação bastante típicos, tais sejam as suas dimensões, modo de reprodução nos tecidos, culturas e inoculações.

Paracoccidioides brasiliensis (SPLENDORE) ALMEIDA, 1930 é o agente etiológico da blastomicose sul-americana. Tudo faz crer que seu habitat seja o reino vegetal e a terra. No entanto, nenhuma pesquisa sistemática foi ainda efetuada, no sentido de se tentar isolar o referido parasita do meio ambiente, bem como de animais que poderiam eventualmente funcionar como reservatórios do referido fungo em a natureza. ,,In vitro'', conseguimos o cultivo do *Paracoccidioides brasiliensis* em diversos substratos vegetais, tendo também MEDINA & BODZIAK (1948) referido o cultivo deste fungo em 49 amostras de terra de várias zonas do Estado do Paraná (Brasil). Verificaram, igualmente, que o *Paracoccidioides brasiliensis* cresce melhor quando o pH está entre 6,0 e 7,8. O crescimento é nulo em terras de pH muito ácido. Em palha de milho, PEREIRA FILHO (1949) também conseguiu obter culturas do *Paracoccidioides brasiliensis*.

Paracoccidioides brasiliensis possui características morfológicas bastante típicas para a sua fácil identificação nos tecidos infectados; no entanto, em certos casos, sua morfologia pode confundir-se com o *Blastomyces dermatitidis* e mais raramente com o *Histoplasma capsulatum*. Suas culturas, conforme a temperatura de incubação, a composição do meio e o pH, podem ser obtidas em duas variantes—cotonosa e cerebriforme. O cobaio inoculado por via testicular constitui o animal de escolha para o estudo experimental da infecção blastomicótica.

A observação clínica de numerosos casos de blastomicose sul-americana revela sua maior freqüência nos trabalhadores rurais, onde a infecção geralmente se manifesta por lesões de estomatite grave (estomatite ulcerosa moriforme), com adenopatia satélite, acompanhadas ou não de lesões cutâneas e comprometimento pulmonar.

Desejamos ressaltar a freqüência com que ocorrem as lesões orofaringeanas na blastomicose sul-americana. Quase sempre tais processos são primários, isto é, lesões iniciais, o doente veiculando o fungo para a bôca através de fragmentos vegetais os mais diversos. Geralmente, os pacientes de blastomicose apresentam os dentes em mal estado de conservação, facilitando a proliferação do fungo.

FONSECA (1957) estudou as lesões dentárias e paradentárias na blastomicose sul americana, mostrando a freqüência da localização peri-odontal nas referidas lesões, com mobilidade franca dos dentes, ao lado de completa destruição do processo alveolar. Na base dêsses achados, que são realmente freqüentes, preconisa FONSECA (1957) a remoção de tais focos, como medida terapêutica auxiliar, administrando-se a medicação sulfamídica como cuidado pré e pós-operatório.

As lesões orofaringeanas na blastomicose sul-americana foram bem estudadas por NOVA (1940), devendo-se registrar, igualmente, a localização laringeana do fungo, determinando lesões da corda vocal que simulam clinicamente a tuberculose e até mesmo processos neoplásicos. O comprometimento pulmonar, primitivo ou secundário a lesões mucosas, é de ocorrência freqüente na blastomicose. Do ponto de vista radiológico, as lesões pulmonares, na blastomicose sul-americana, apresentam quadros radiológicos diversos, podendo simular a tuberculose e em certos casos os dois processos se associam, o que dificulta o diagnóstico diferencial. Na vigência do comprometimento pulmonar, com lesões extensas, o tratamento sulfamídico conduz à cura clínica, com limpeza do quadro radiológico, restando porém, intensa fibrose que pode conduzir os doentes a um quadro de ,,cor pulmonale crônico''. Para se evitar êste quadro, alguns AA. têm preconisado o emprêgo concomitante de hormônios corticóides à medicação sulfamídica.

Na blastomicose sul-americana, não existem descritos casos de calcificações pulmonares filiados de modo específico ao processo micótico, tal como ocorre em casos de histoplasmose. O problema da ,,blastomicose-infecção'' está ainda em fase preliminar de investigações. Nossa opinião pessoal é a de que a capacidade de sensibilização do *P. brasiliensis* é muito pequena e as reações positivas que se obtêm com a paracoccidioidina, em sua maioria, correm por conta de ,,reações cruzadas'' com a histoplasmina, tal como se verifica com a blastomicetina, nos Estados Unidos. Todavia, o problema merece ser investigado, principalmente depois que AMADEU FIALHO (1946) demonstrou anátomo-patológicamente a ocorrência de lesões pulmonares regressivas, como fenômeno espontâneo, em paciente que não tomara medicação sulfamídica. Assim, observou-se neste caso, a formação de nódulos fibrosos, com organização conjuntivo-histiocitária e início de calcificação.

É provável, na opinião de LACAZ (1951; 1955—1956) e de MACKINNON & colab. (1953) que existam formas subclínicas ou benignas de blastomicose, mas como são freqüentes as reações cruzadas da paracoccidioidina em casos de histoplasmose-infecção, muito critério precisa ser tomado quando se interpreta uma prova positiva à paracoccidioidina. Devemos registrar que a sensibilidade dêsse antígeno em casos comprovados de blastomicose é relativamente pequena.

NEGRONI & colab. (1952) em 2.213 reações praticadas em crianças de escolas rurais do Sul de Tucumán e Santiago del Estero (Argentina), encontraram vários reagentes positivos, sendo que a incidência mais elevada — de 4,68 % foi obtida em ,,Los Bulbacio'' (Tucumán).

As lesões cutâneas na blastomicose sul-americana, quase sempre secundárias a um processo de localização mucosa, podem apresentar quadros dermatológicos os mais diversos. Pràticamente tôdas as lesões elementares da pele são encontradas em casos de blastomicose tegumentar. Êste problema foi analisado principalmente por CUNHA MOTTA & AGUIAR PUPO (1936) a quem ae devem a sistematização do estudo anátomo-clínico das lesões cutâneas na blastomicose sul-americana. Formas generalizadas são explicadas pela disseminação hematogênica do fungo, tendo sido o parasita isolado, repetidas vêzes, por hemocultura, de tais casos.

O comprometimento ganglionar é igualmente bastante freqüente e quando tal processo atinge os gânglios abdominais, devido à compressão de alças intestinais ou dos ductos biliares extra-hepáticos, sintomatologia semelhante a de quadro tumoral pode ser eventualmente observada.

Formas viscerais, localizações ósteo-articulares, lesões do sistema nervoso central e de glândulas endócrinas têm sido igualmente referidas.

A blastomicose sul-americana é bastante sensível à medicação sulfamídica. Tanto ,,in vitro'' como ,,in vivo'' diversos preparados sulfamídicos exercem manifesta ação sôbre o *Paracoccidioides brasiliensis*. Curas clínicas se obtêm com a referida medicação, devendo os doentes, porém, submeterem-se a tal tratamento durante tempo indeterminado, já que as recidivas são muito freqüentes.

Recentemente, vimos empregando com Sampaio, o Amphotericin B (Fungizone) por via venosa, no tratamento da blastomicose sul-americana, com excelentes resultados, talvez superiores ao da própria medicação sulfamídica. No contrôle de cura desta infecção, ao lado do exame clínico, duas provas devem ser feitas rotineiramente: a reação de fixação do complemento e a hemossedimentação. FAVA NETTO (1955) padronizou a reação de fixação do complemento, na blastomicose, utilizando como antígeno um polissacáride obtido de culturas leveduriformes do *Paracoccidioides brasiliensis*. A prática desta reação, em moldes quantitativos, tem oferecido excelentes resultados para se ajuizar do prognóstico da infecção, bem como do seu contrôle de cura.

Blastomicose Queloideana

(Blastomicose de Jorge Lôbo)

A blastomicose queloideana ou blastomicose ,,tipo Jorge Lôbo" constitui, segundo nosso modo de ver, dermatose autônoma, com características clínicas, anátomo-patológica e micológica próprias e determinada por nova espécie de *Paracoccidioides* — o *Paracoccidioides Loboi*.

Vários elementos justificam colocar o agente da blastomicose queloideana em espécie distinta do *Paracoccidioides brasiliensis*. Descrita em 1931 pelo Prof. JORGE LÔBO, do Recife e considerada inicialmente por muitos pesquisadores como forma anátomo-clínica da blastomicose sul-americana, tal afecção é tida hoje em dia como entidade independente, determinada pelo *Paracoccidioides Loboi* ALMEIDA & LACAZ, 1948—1949. Reina ainda ceita confusão no que diz respeito à exata denominação genérica ao agente da blastomicose queloideana. Sem entrar no mérito dessa questão, devemos referir que vários dados falam a favor da individualização desta dermatomicose. Assim, a blastomicose queloideana é primitivamente cutânea, com ausência de comprometimento visceral; as lesões são de longa duração, mantendo-se conservado o estado geral do paciente; êstes procedem, em sua maioria, da bacia amazônica. As lesões podem apresentar localização a mais diversa, predominando o processo nas pernas e regiões auriculares. Do ponto de vista dermatológico múltiplas lesões podem ocorrer: pápulas, nódulos, lesões verrucosas, e tuberosas bem como estruturas queloideanas, o que lhe valeu a adjetivação dada por JORGE LÔBO. A maiorio dos doentes procede da Amazônia, exceto um caso observado em Costa Rica por TREJOS & ROMERO (1953). Os doentes são constituídos, em sua maioria, de seringueiros, havendo dois casos em mulheres. PEREIRA-FILHO (1957) assinalou em dois índios do Brasil Central (Acuxi e Ciriro-Cruá), internados no Hospital Evandro Chagas (Rio de Janeiro), lesões blastomicóticas cutâneas, caracterizadas pelo aparecimento de nódulos e tubérculos. Lesões atróficas cutâneas também foram verificadas, simulando clìnicamente lepra tuberculóide. PEREIRA-FILHO (1957) refere que novos estudos talvez levem o fungo da doença dos índios do Alto Xingú (Brasil Central — Estado do Mato Grosso), para nova espécie ou variedade muito próxima do *Paracoccidioides Loboi*. Nossa impressão é a de que tal dermatose se enquadra dentro da blastomicose queloideana. Todavia, parece-nos que maior riqueza de parasitas se observa neste último tipo de blastomicose. Os métodos de GRIDLEY & GOMORI são excelentes para a demonstração dêsses fungos. NERY GUIMARAES & MACEDO (1950) registram que a ,,blastomicose queloideana'' é própria de zonas de matas, com calor e umidade relativas elevadas; ataca, de preferência, trabalhadores em florestas e agricultores, como é o caso dos seringueiros da Amazônia; daí a sua ocorrência predominante no sexo masculino.

Até o presente momento são conhecidos 21 casos de blastomicose queloideana,sendo 2 em índios do Brasil Central. Uma observação, do Dr. Gilberto de Azevedo Teixeira, do Instituto Nacional de Pesquisas da Amazônia, foi registrada no trabalho de Pereira-Filho (1957).

O exame anátomo-patológico das lesões queloideanas revela grande riqueza de parasitas, histiocitose intensa, sem a formação de granulomas individualizados, retículo-endoteliose do derme, com proliferação das células de Langhans, nunca se observando a reprodução do cogumelo por cripto-esporulação, comumente assinalada em material de granuloma paracoccidióidico. Monteiro Leite (1954) registra com razão, que o quadro histopatológico da doença de Lôbo é bastante típico para permitir a sua distinção de qualquer outra lesão blastomicótica. Em exame a fresco, *Paracoccidioides Loboi* se apresenta como parasitas arredondados, isolados ou em grupos, com dupla membrana nítida, bem refringente. A membrana é mais espêssa que a do *Paracoccidioides brasiliensis* e a riqueza dos elementos parasitários nas lesões é impressionante.

As culturas do *Paracoccidioides Loboi* são dificilmente obtidas, tal fato decorrendo de uma exigência biológica do microrganismo ou, então, porque a maioria se encontra destruída, dada a intensa fagocitose observada nas lâminas. Ciferri & colab. (1956) estabeleceram diferenças microscópicas entre *P. brasiliensis* e *P. Loboi,* levando em consideração a morfologia das células-mãe (esporângios), bem como das gêmulas e criptósporos. Na base dêsses elementos, criaram Ciferri & colab. (1956) o gênero *Loboa* para nele enquadrar o agente da blastomicose queloideana.

As inoculações em testículo do cobaio, a partir do material retirado das lesões, não oferecem a possibilidade de obter processos experimentais, com facilidade. Com o material retirado dos dois índios do Brasil Central, Pereira-Filho (1957), em hamsters, conseguiu obter orquite, pouco acentuada, sem haver visceralização do processo infetante.

Lemos Monteiro, com o material de um caso por nós observado, reproduziu interessantes lesões em ovos embrionados, parecendo àquele pesquisador serem diferentes das determinadas pelo *P. brasiliensis.* Se não bastassem essas características já assinaladas para diferençar a blastomicose sul-americana da blastomicose queloideana, devemos registrar, como dado complementar, que a reação de fixação do complemento com o polissacáride do *P. brasiliensis* foi negativa em um caso de blastomicose queloideana que observámos em 1955, em colaboração com Sterman, Lemos Monteiro & Outeiro Pinto.

Blastomicose Norte-Americana

Os casos registrados no Brasil e na Argentina como de blastomicose norte-americana são, ao que tudo faz crer, novas observações de blastomicose sul-americana. Realmente, em tais casos os diagnóstico ce moléstia de Gilchrist foi feito na base de dados anátomo-patológicos, pois considerava-se o *Paracoccidioides brasilienses* como incapaz de produzir brotamento único, forma de reprodução muito característica do *Blastomyces dermatitidis*. Na monografia publicada por NIÑO, em 1938, são referidos alguns casos, na Argentina, de blastomicose norte-americana; todavia, pelo quadro clínico e histopatológico, chega-se à conclusão de que tais observações, são na realidade, de blastomicose sul-americana. O *Paracoccidioides brasiliensis* pode, nos tecidos, reproduzir-se por criptoesporulação, bem como por brotamento simples, confundindo-se em tais casos, com o *Blastomyces dermatitidis*.

Do ponto de vista prático, al blastomicose norte-americana não ocorre no continente sul-americano. POLO & colab. (citados por CAMPINS, 1955) referem-se a um caso desta natureza, observado na Venezuela, com lesões mucosas e ganglionares. Formas do parasita, em brotamento, foram encontradas, e obtidas as culturas. O diagnóstico exato se estabeleceu graças aos estudos efetuados por MACKINNON, no Uruguai.

Criptococose

Em diversos países da América do Sul, a granulomatose criptocócica tem sido observada, com sintomatologia clínica que se enquadra dentro das formas já conhecidas dessa infecção. No Brasil, foram assinalados casos de criptococose, tendo REIS & BEI, em 1956, estudado de maneira completa o seu quadro liquórico, concluindo que as alterações encontradas assemelham-se às assinaladas em casos de meningite tuberculosa. Casos esporádicos de criptococose foram descritos na Venezuela, Argentina, Equador e Chile.

Desejamos, neste particular, registrar o trabalho monográfico de NIÑO, publicado em 1934, no qual êste micologista argentino estuda do ponto de vista clínico, micológico, anátomo-patológico e experimental um caso generalizado de criptococose ocorrido na Argentina. Nada de particular apresenta a criptococose na América do Sul, que mereça registro especial.

Cromomicose

A cromomicose ou cromoblastomicose ocorre com relativa freqüência na América do Sul, principalmente no Brasil. Aliás, os quatro casos descritos pela primeira vez, de cromomicose, o foram em São Paulo, por PEDROSO & GOMES, em 1920. Segundo os dados colhidos por BARBOSA DA SILVA (1955), até 1955 haviam sido registrados no Brasil, 168 casos de cromomicose. Assinale-se o número relativamente grande de teses e trabalhos monográficos publicados sôbre o assunto, no Brasil. Assim, MELLO CAVALCANTI (1924), PEREIRA (1938), TIBIRIÇÁ (1939), AZULAY (1944), ALEIXO (1946), GUIMARAES (1951) e BARBOSA DA SILVA (1955) estudaram o referido problema sob os aspectos dermatológico ou anátomo-patológico, já que a confusão no domínio micológico ainda persiste. NEVES DA SILVA (1949) em 145 casos de micoses, verificou a ocorrência de 9 observações de cromomicose, com incidência de 6,2 %. Na Venezuela, a cromomicose é relativamente frequente, tendo CAMPINS & SCHARYJ (1953) assinalado 34 casos.

O quadro clínico da cromomicose é bastante típico para a sua individualização, podendo ocorrer, porém, formas atípicas, simulando „tuberculosis cutis verrucosa". TIBIRICÁ (1939) considerou três formas anátomo-clínicas, a saber:

1) Verrucosa nodosa, constituída por verrugas isoladas.
2) Verrucosa confluente.
3) Verrucosa ulcerosa ou úlcero-verrucosa.

Outras modalidades clínicas têm sido observadas e descritas, tais como a sarcoídica, a tuberculóide, a sifilóide, a psoriasiforme, a cicatricial ou elefantiásica e a eczematóide. Ao lado de lesões estritamente cutâneas, devemos referir a localização mucosa, já registrada em nosso meio por HILTON ROCHA (1943) que descreveu um caso com processo inflamatório conjuntival. Lesões de linfangite, simulando esporotricose, também têm sido registradas.

Como valiosa contribuição para o estudo da cromomicose deve ser mencionado o trabalho de ARÊA LEÃO & colab. (1947), sôbre a reprodução experimental da referida micose em camundongos, hamsters e rãs, inoculados por diversas vias. Subsídio também de valor oa estudo da cromomicose foi o trabalho de BOPP (1957), referindo em 20 casos, o emprêgo do iodeto de sódio a 10 % associado à vitamina D_2; esta última, administrada por via oral, em solução alcoólica — 600.000 unidades, pela manhã e em jejum, semanalmente, num total de 15 a 25 doses, determina segundo BOPP (1957) proliferação conjuntival, com acentuação da reação histiocitária e atenuação do processo supurativo, conduzindo a resultados clínicos altamente favoráveis.

FARINA (1950) ensaiou em alguns casos, como tratamento da cromomicose, a remoção ampla das lesões, tendo como limite o plano aponeurótico, reparando a extensa perda de substância com enxêrto livre de pele.

Histoplasmose

O número de casos de histoplasmose, na América do Sul, tem aumentado, a medida que se intensificam os trabalhos no sentido de sua caracterização. No Brasil, a maioria dos casos de histoplasmose foi assinalada na mesa de autópsia; assim, de 10 casos já registrados, no Brasil, de histoplasmose doença, sòmente em dois o diagnóstico foi estabelecido em vida. Previa-se, no Brasil, como em outros países do continente sul-americano, a ocorrência da histoplasmose-doença, tendo-se em vista a incidência relativamente elevada de indivíduos reagentes positivos à histoplasmina. Uma das últimas estatísticas por nós registradas, baseadas em inquérito realizado na Cidade de São Paulo, em 500 indivíduos, assinala positividade de 19 % de reagentes positivos àquele antígeno.

Devemos referir que MADUREIRA PARÁ, em 1946, descrevendo as lesões hepáticas em 5 casos de histoplasmose, encontrou em um cão que tivera contato com um dos casos, a presença de *Histoplasma capsulatum.* Ainda no Brasil, deve ser registrada a ocorrência do *Histoplasma capsulatum* no solo (Estado da Bahia), bem como em *Rattus norvegicus,* verificação esta efetuada por M. E. DA SILVA (1956). Do solo da Guiana Francêsa, FLOCH (1957) isolou, igualmente, amostras típicas de *Histoplasma capsulatum.*

Na Venezuela, CAMPINS & colab. (1955) assinalaram histoplasmose em um grupo de excursionistas que visitaram uma gruta, no Estado de Lara. Formas graves e benígnas da infecção foram registradas. Do solo da referida gruta, foi isolado o agente infectante, presumindo-se que o mesmo encontra condições favoráveis de proliferação em lugares ricos em matéria orgânica e úmidos.

Assinale-se que na Argentina, numerosos casos de histoplasmose têm início com lesões orofaringeanas, simulando clìnicamente a blastomicose sul-americana.

Valiosa contribuição para o estudo da histoplasmose no continente sul-americano é a de FREIJO (1949), no Uruguai.

Na Venezuela, inquérito realizado por CAMPINS & SCHARYJ, em 1949, em 1.836 escolares de Barquisimeto revelava 13,7 % de reagentes positivos, dos quais 44 tinham lesões pulmonares residuais, predominantemente calcificadas e atribuídas ao *Histoplasma capsulatum.* CAMPINS (1955) refere 16 casos de histoplasmose, bem comprovados, na Venezuela, dos quais 14 com localização pulmonar.

Na Argentina, NEGRONI (1957), faz referências a 25 casos, com lesões ulcerosas da mucosa bucal, faríngea, laringea ou nasal, acompanhadas de adenopatia satélite. Muitos dêsses casos foram curados com a medicação sulfamídica. NIÑO (1957) assinala 28 observações na Argentina.

No Chile, POZO AGUIRRE (1957), em 6.417 reações de histoplasmina, refere apenas 32 positivas (0,5 %), tendo sido publicado apenas um caso de histoplasmose-doença, poi OLIVARES & colab. (1952). Alguns dados sôbre a incidência de reações à histoplasmina estão contidos no quadro anexo.

Com referência aos aspectos do *Histoplasma capsulatum* nos tecidos, devemos referir que em um dos casos que publicámos com ALMEIDA (1933), associado à cromomicose, verificámos a ocorrência de formas parasitárias grandes, muito semelhantes às do *Histoplasma capsulatum duboisii,* agente da chamada ,,histoplasmose africana''.

País	*Autores*	*Incidência de positividade*
Brasil	Lacaz & colab.	19 %
Brasil	Alvimar de Carvalho	16,4 %
Chile	Pozo Aguirre	0,5 %
Uruguai	Freijo	8,9 %
Paraguai	Gines & colab.	18 a 31 %
Venezuela	Campins & Scharyj	13,7 %

Coccidioidomicose

Durante muitos anos, no Brasil, a blastomicose sul-americana foi confundida com a coccidioidomicose. Graças aos trabalhos de Splendore (1912) e principalmente de Almeida (1933), diferenças marcantes foram estabelecidas entre os fungos dos dois processos micóticos, individualizandose, então, a blastomicose sul-americana como entidade bastante diferente da granulomatose coccidióidica. O quadro anexo resume tais diferenças.

Coccidioides immitis	*Paracoccidioides brasiliensis*
Dimensões do parasita — De 3 a 80 micra	De 1 a 40 micra
Reprodução nos tecidos — Formação e diferenciação de esporos no interior da célula; ruptura e eliminação dos esporos.	Esporos exógenos (Cripto-esporulação) ou reprodução por brotamento unico.
Culturas — Facilmente obtidas nos meios comuns de laboratório. Início no 2° dia. Culturas filamentosas.	Obtidas com dificuldade. Início de desenvolvimento entre o 20—30° dia. Crescimento lento. A 37°C, culturas leveduriformes. À temperatura ambiente, variante filamentosa ou cotonosa.
Inoculações — Positivas em cobaios inoculados por qualquer via. Generalização das lesões.	Resultados positivos sòmente por via testicular, em cobaios. Não há generalização das lesões.

No Brasil, até o presente momento, nenhum caso de coccidioidomicose foi comprovado, o mesmo ocorrendo em outros países sul-americanos, como o Chile, por exemplo. É provável que as condições ambientais — clima e solo desses países, dificultem o desenvolvimento do fungo em sua vida saprofítica. Aliás, devemos registrar que alguns inquéritos efetuados no Brasil, com a coccidioidina, resultaram negativos. Recentemente, em 500 doentes internados no Hospital das Clínicas de São Paulo e procedentes de diversos pontos do Brasil, praticámos um inquérito, com a coccidioidina, resultando o mesmo negativo.

Fato interessante é que em outros países do continente sul-americano, a doença ocorre endêmicamente. Aliás, a coccidioidomicose foi pela primeira vez assinalada na Argentina, por POSADAS, em 1892.

Em 1948 FLAVIO NIÑO, examinando material preservado, do caso original de POSADAS, encontrou microrganismos típicos, característicos do *Coccidioides immitis.*

Segundo NEGRONI (1957) existe, na Argentina, uma zona árida, endêmica, de coccidioidomicose, que se estende desde o paralelo 27,5° a 40°, de latitude sul. A incidência de reagentes positivos à coccidioidina oscila de 18 a 27 %. Refere NEGRONI (1957) que a coccidioidomicose, na Argentina, não constitui problema sanitário, na atualidade, pois se conhecem apenas 15 casos desta infecção.

Em 1950, NIÑO & colab. publicaram a 12° observação de coccidioidomicose na Argentina, em doente que apresentava quador de osteíte do tarso, vindo de zona endêmica de coccidioidomicose.

MACKINNON (1948), no Uruguai, registrou caso de granulomatose coccidióidica em doente boliviano, acreditando que a área de coccidioidomicose deva ser na América do Sul, mais ampla. MACKINNON (1948) registra que o fungo descrito em 1938 por NEGRONI & VALLAFANE-LASTRA como *Trichosporon proteolyticum* deve ser considerado como *Coccidioides immitis.* O mesmo se diga em relação ao chamado *Pseudococcidioides Mazzai*, segundo observações de ALMEIDA (1934).

Na Venezuela, a granulomatose coccidióidica já foi igualmente registrada, com número reduzido de casos. CAMPINS (1955) demonstrou a existência de reagentes positivos à coccidioidina, com intensidade variável conforme a região; assim, no Estado de Lara, caracterizado por regiões áridas quentes, com vegetação xerófila, ambiente propício ao desenvolvimento do *Coccidioides immitis*, a incidência percentual de reagentes positivos à coccidioidina foi maior. Em 6.616 indivíduos, CAMPINS (1950) obteve positividade de 1,1 % a 46,4 % conforme as zonas do país onde realizou o inquérito.

No Chile, segundo os dados de POZO AGUIRRE (1957) a coccidioidomicose não foi ainda descrita. Entre 4.184 indivíduos examinados, de diversas idades e localidades, sòmente 9 reagiram positivamente à coccidioidina (0,2 %).

Rinosporidiose

Na América do Sul, a rinosporidiose tem sido assinalada no homen e em eqüinos.

Em 1946, THIAGO DE MELLO estudou no Brasil, a rinosporidiose e o *Rhinosporidium Seeberi*, oferecendo valiosa contribuição ao estudo dêsse fungo.

No Brasil, 16 casos de rinosporidiose já foram registrados, com localização nasal (a maioria) e conjuntival. Nenhum aspecto particular, do ponto de vista clínico ou histopatológico, foi verificado nos casos acima referidos.

Na Venezuela, Argentina e Equador, casos isolados de rinosporidiose também já foram observados. NIÑO & FREIRE (1957) assinalam a existência de um foco endêmico de rinosporidiose na província do Chaco.

Esporotricose

A esporotricose é relativamente comum na América do Sul, principalmente no Brasil. Entre os anos de 1945 e 1953 foram matriculados no Ambulatório de Dermatologia do Hospital das Clínicas de São Paulo, 104 casos de esporotricose. Considerando-se que o total de matrículas neste ambulatório, naquele período, foi de 20.470 pacientes, tem-se uma freqüência, para a esporotricose, de 0,5 % em relação às demais dermatoses.

MACKINNON (1948) e NEVES DA SILVA (1951) assinalam que um alto grau de umidade e temperatura entre 16 e 20°C, devam constituir condições que aumentem a proliferação dos esporotricados em a natureza e, por conseguinte, possibilitam maiores probabilidades de contágio.

Em 1954, SAMPAIO & colab., no Brasil, examinando 235 casos de esporotricose, na base de um critério morfológico e topográfico, classificaram tais lesões em:

1) Forma cutâneo-linfática ou linfática.
2) Forma cutânea localizada (dermo-epidérmica).
3) Forma cutânea disseminada.
4) Formas extra-cutâneas.

ALMEIDA & colab. (1955) assinalaram que os ferimentos por espinhos de plantas e palha constituiram, em sua estatística, os agentes que, com maior freqüência, proporcionaram o aparecimento da esporotricose. Os diapositivos que projetaremos mostram a variedade das manifestações dermatológicas que a esporotricose é capaz de determinar.

Desejamos ressaltar no diagnóstico da esporotricose, o grande valor da esporotriquina (formas filamentosa e em naveta), prova intradérmica que se tem mostrado bastante sensível e específica no diagnóstico desta micose, em qualquer uma de suas formas anátomo-clínicas. RAMOS E SILVA & PADILHA GONÇALVES (1950) concluíram que a referida prova permite reforçar um diagnóstico clínico de esporotricose, em 48 horas, sendo que a capacidade reacional dos esporotricósicos ao referido antígeno é duradoura. Deve-se ressaltar ainda o valor da prova no tratamento da esporotricose, segundo observações bem conduzidas de NORONHA MIRANDA & colab. (1953).

A medicação iódica é altamente eficaz no tratamento da esporotricose; todavia, outras medicações também se têm mostrado eficazes, se bem que empregadas em casos isolados. Nossa experiência com a esporotriquina se eleva a mais de 100 casos, tendo sempre obtido resultados bastante convincentes quanto ao grande valor da referida prova no diagnóstico imuno-alérgico da esporotricose. No momento atual, estamos trabalhando exclusivamente com a „esporotriquina-naveta'', obtendo-se a variante leveduriforme do *Sporotrichum Schenckii.*

Belliboni & Patrício (1956) trataram com êxito dois casos de esporotricose com o „Glucantime'' (antimoniato de N-metil-glucamina), preparado que anteriormente já havia sido ensaiado por Baptista & colab. (1952). Não se conhece o mecanismo exato de ação da droga, já que a mesma não possui „in vitro'' ação fungistática sôbre o *Sporotrichum Schenckii.*

Raríssimos casos de micoses gomosas por outros fungos que não os do gênero *Sporotrichum* têm sido assinalados no continente sul-americano, tais como lesões provocadas por fungos dos gêneros *Hemispora, Cladosporium, Cephalosporium, Acladium, Acremoniella* e *Acremonium.*

Actinomicose

A actinomicose ocorre na América do Sul com relativa freqüência. No Brasil, predominam os casos de localização podal, provocados pelo *Actinomyces* (*Nocardia*) *brasiliensis,* fungo identificado em 1909, por Lindenberg, em São Paulo. Mais raros são os casos determinados pelo *Cohnistreptothrix Israeli* (*Actinomyces bovis*), geralmente sob a forma de lesões cérvico-faciais ou tóraco-pulmonares. O mesmo fato não ocorre, porém, em outros países do continente sul-americano, onde a forma cérvico-facial de actinomicose é a mais frequente. A actinomicose, sob o aspecto clínico e micológico, mereceu de nossa parte, em 1945, estudo aprofundado, devendo-se citar também as contribuições de Yasbek (1920) e de Mackinnon & Artagaveytia-Allende (1956), esta última sob o aspecto micológico. As lesões ósseas são relativamente freqüentes na actinomicose e sôbre tais processos publicamos em 1945, trabalho monográfico.

A actinomicose provocada pelo *Actinomyces brasiliensis* não existe sòmente no continente sul-americano, pois em 1956 Vanbreuseghem & colab. (1956) registraram dois casos de actinomicose por aquêle fungo em indígenas do Congo Belga. Assinale-se também a presença do mesmo fungo, no México, com estudos de Gonzales Ochoa (1945), principalmente. No Brasil, Almeida, em 1940, descreveu um caso de actinomicose torácica em agricultor canadense, que residia há anos no Chaco paraguaio; tal caso, segundo Almeida (1940) foi provocado por nova espécie de *Actinomyces* — o *Actinomyces paraguayensis.* Mackinnon & Artagaveytia-Allende (1956) acreditam ser o *Actinomyces paraguayensis* espécie muito próxima ao *Streptomyces albus*. Casos raros de actinomicose determinados pelo *Actinomyces Pelletieri* (Laveran, 1906), bem como pelo *Actinomyces madurae* (Vincent, 1894) também já foram descritos no continente sul-americano.

Nada de particular apresenta o estudo da actinomicose no continente sul-americano. Apenas desejamos assinalar o grande valor da medicação sulfamídica (Sulfisoxazol, por exemplo) e sulfonamídica no tratamento da actinomicose pelo *Actinomyces brasiliensis*. Esta última medicação foi ensaiada pela primeira vez, no México, por Ochoa & colab. (1952).

Maduromicose

A maduromicose, em relação à actinomicose, é de distribuição muito limitada. Trata-se de infecção relativamente rara, com localização predominantemente podal, de marcha crônica, não comprometendo o estado geral do doente, podendo-se clìnicamente separar tais processos dos de natureza actinomicótica. Assim, as lesões de maduromicose não são geralmente piogênicas, tratando-se mais de processo fibroplástico, duro à palpação, com depressões e elevações mamelonadas. Quase sempre é escassa e secreção serosanguinolenta que se elimina pelas fístulas.

No Brasil, segundo Lacaz & Fava Netto (1954) cogumelos identificados como *Monosporium apiospermum*, *Cephalosporium falciforme* e *Madurella grisea* são os mais freqüentemente isolados de casos de maduromicose. No Brasil, até 1957, 20 casos de maduromicose haviam sido registrados, sendo que apenas um de localização cervico-facial e provocado por espécie não identificada de *Madurella*. Tal observação, de Corrêa & Fava Netto (1953) refere-se a um caso de maduromicose das face, com aspecto de lesões fistulizada múltiplas.

Madurella grisea constitui espécie de fungo causador de maduromicose e identificado por Mackinnon & colab. (1949), no Uruguai, seguindo-se a observação de outros casos, no Brasil e também, fora do continente sul-americano. Assim, em 1956, Vanbreuseghem referia uma observação de maduromicose provocada por êste fungo, no Congo Belga e Neuhauser (1955), novo caso, nos Estados Unidos.

Além da maduromicose cutânea, segundo Mackinnon & colab. (1949), fungos anemófilos diversos, principalmente do gênero *Aspergillus*, quando inalados, podem determinar lesões parenquimatosas que no seu estadio evolutivo final, modificam o aspecto do cogumelo no tecido, assumindo o fungo formas de grão, como que elementos enclausurados. Mackinnon & colab. (1949) registram, neste particular, observação de Sotello, de paciente que falecera com lesões de fibrose pulmonar, pleural e pericárdica. Em tais lesões comprovou-se a existência de grãos parasitários, possìvelmente do *Aspergillus fumigatus*.

Acremoniella Lutzi LEÃO & LÔBO, 1940, isolada de um caso de maduromicose, no Brasil, foi considerada por MACKINNON (1954) como sinônimo de *Monosporium apiospermum.* Êste último cogumelo também já foi isolado na Argentina e em outros países da América do Sul.

Além das micoses profundas referidas anteriormente, devemos assinalar a ocorrência, na Argentina, de micoses pulmonares por cogumelos do gênero *Trichosporon.* NEGRONI (1957) registra dois casos de lesões pulmonares pseudotuberculosas, ambos da província de San Juan, cujos agentes foram identificados como *Trichosporon cutaneum* e *Trichosporon fermentans,* respectivamente.

Em 1918, em Minas Gerais (Brasil), OCTAVIO MAGALHÃES assinalou micose pulmonar provocada pelo *Neogeotrichum pulmoneum.* Segundo MACKINNON (1945), porém, esta levedura deverá passar para a sinonímia de *Candida suaveolans.* Em 1919, DIAS DA COSTA, em sua tese de doutoramento, estudou novamente o cogumelo, registrando mais sete casos da referida micose. Discute-se se tal cogumelo representa, realmente, o agente etiológico da manifestaçao pulmonar apresentada pelos pacientes.

Como complemento a êste relatório, devemos assinalar que no Brasil, SPINA FRANÇA NETTO & colab. (1953) assinalaram um caso considerado como de cromomicose do sistema nervoso; todavia, o aspecto do parasita nos cortes histológicos sugere a possibilidade de se tratar de ,,Cladosporiose'' do sistema nervoso. O paciente apresentava síndrome de hipertensão intracraniana com 4 meses de evolução progressiva. Clìnicamente foi verificada hemiparesia direita e papiledema bilateral. Como não foi praticada cultura, nada podemos afirmar sôbre o fungo agente do referido processo. Uma das hipóteses que levantamos é a de que se trate de micose cerebral por *Cladosporium trichoides.*

Recentemente, em colaboração com BRITO & LOPES DE FARIA observámos um caso de cladosporiose do sistema nervoso central, em paciente que apresentava quadro de hidrocefalia; a autópsia revelou a presença de um processo granulomatoso, de origem fúngica, localizado na extremidade distal do aqueduto de Sylvius. Epêndima levemente espessado ao nível dos ventrículos laterais e do teto do IV ventrículo.

Acreditamos ter focalizado, de maneira sucinta, os aspectos anátomo-clínicos e epidemiológicos das micoses profundas que ocorrem no continente sul-americano.

Resumo

As micoses profundas ocorrem com relativa freqüência na América do Sul. Apenas a mucormicose e as micoses por cogumelos dos gêneros *Cercospora* e *Basidiobolus* ainda não foram assinaladas nesta parte do continente americano. Em contraposição, duas micoses são peculiares ao território sul-americano: a blastomicose sul-americana e a blastomicose queloideana ou ,,blastomicose tipo Jorge Lôbo''. Esta última infecção foi particularmente descrita em seringueiros da Amazônia, bem como entre indígenas do Brasil Central, sendo no entanto, de distribuição muito limitada.

Analisando os aspectos epidemiológicos das micoses profundas da América do Sul, o Autor descreve, de modo resumido, a sua geografia regional, para mostrar logo em seguida o interêsse da blastomicose sul-americana, infecção de decurso geralmente grave, provocada por *Paracoccidioides brasiliensis* e já assinalada em quase todos os países da América do Sul.

Todos os principais dados referentes à história desta infecção distribuição geográfica, aspectos micológicos, fontes de infecção, formas anátomo-clínicas, diagnóstico diferencial, diagnóstico de laboratório, anatomia patológica, tratamento e contrôle de cura são apresentados.

A blastomicose queloideana ou ,,blastomicose de Jorge Lôbo'' é considerada como entidade clínica diferente da blastomicose sul-americana e provocada por nova espécie de *Paracoccidioides* — o *P. Loboi*. A blastomicose queloideana foi também assinalada entre índios do Brasil Central. A conceituação desta nova blastomicose é baseada em dados anátomo-clínicos, histopatológicos, micológicos e imunológicos.

Quanto à blastomicose norte-americana, acha o Autor que a maioria dos casos descritos refere-se, na realidade, à blastomicose sul-americana. A criptococose ocorre também no continente sul-americano, sem apresentar nada de importante quanto a suas características. Em relação à cromomicose, ela é relativamente freqüente, principalmente no Brasil, onde diversos trabalhos monográficos e teses foram publicados sôbre o assunto. Destaca-se, na parte de tratamento da cromomicose, o ensaio efetuado por BOPP (1957), com excelentes resultados, associando a vitamina D_2 à medicação iódica.

A histoplasmose tem sido muito estudada nesses últimos anos em diversos países da América do Sul, principalmente depois que inquéritos com a histoplasmina revelaram incidência relativamente elevada de reagentes positivos àquele antígeno. Do solo e de animais silvestres e domésticos, o *Histoplasma capsulatum* já foi isolado, tal como tem ocorrido em outras partes do mundo. Quanto à coccidioidomicose, tal infecção ainda não foi assinalada no Brasil, não constituindo também, para outros países sul-americanos, problema epidemiológico de importância. A coccidioidomicose foi

registrada na Venezuela e na Argentina, por exemplo, mas em número limitado de casos.

A rinosporidiose foi estudada, no Brasil, principalmente por Thiago de Mello, a maioria dos casos sendo de localização nasal.

No que diz respeito à esporotricose, ela é bastante freqüente, principalmente no Brasil, onde cêrca de 0,5 % das dermatoses é de etiologia esporotricótica. Formas clínicas as mais diversas são de observação freqüente nos ambulatórios de dermatologia. A contribuição dos pesquisadores brasileiros no que diz respeito ao valor da prova da esporotriquina no diagnóstico da esporotricose é grande, ressaltando-se sua extrema sensibilidade (esporotriquina preparada com a variante em naveta, do *Sporotrichum Schenckii*). A actinomicose ocorre mais freqüentemente que a maduromicose, sendo em muitos casos determinada pelo *Actinomyces brasiliensis*, fungo identificado pela primeira vez, no Brasil, por Lindenberg, em 1909. Quanto à maduromicose, cogumelos identificados como *Monosporium apiospermum*, *Cephalosporium falciforme* e *Madurella grisea*, são os mais freqüentemente isolados de tais processos.

Finalizando o trabalho, o Autor discute a micose pulmonar pelo *Neogeotrichum pulmoneum*, referindo também dois casos de neuromicose provocados provàvelmente pelo *Cladosporium trichoides*.

Summary

Clinical and Epidemiological Aspects of Deep Mycoses in South America.

Deep mycoses are frequent in South America. Exceptions are the mucormycosis and mycoses produced by fungi of the genus *Cercospora* and *Basiodobolus*, which up to date, were not found on this continent. On the other hand, two deep mycoses are peculiar of the South American territory; they are, South American Blastomycosis, and Keloid-Blastomycosis, or ,,Jorge Lôbo blastomycosis''. This last kind of blastomycosis has a limited distribution and is found only in persons who work in latex extraction in Amazonas and among Indians in the central part of Brazil.

Analysing the epidemiological aspects of the deep mycoses in South America, the Author describes briefly its regional geography, with the purpose of emphasizing the great importance of South American blastomycosis — a deep mycosis produced by *Paracoccidioides brasiliensis*, which almost always has a serious course and which was found in almost all the South American countries.

All the principal data concerning the history, geographical distribution, mycological aspects, sources of infection, anatomoclinical forms, differencial diagnosis, laboratory diagnosis, anatomopathology, treatment, and control of cure of this infection are presented.

The keloid-blastomycosis, or ,,Lôbo's blastomycosis'', is considered a clinical entity different from South American blastomycosis and produced by a new species of *Paracoccidioides*: the *Paracoccidioides Loboi*. In the conception of this new form of blastomycosis, anatomo-clinical, histo-pathological, mycological and immunological data were taken in account.

Concerning the North American blastomycosis the Author believes that the majority of the cases referred to were, in reality, cases of South American blastomycosis.

Cryptococcosis is found in South American countries with the classical aspects.

Cromomycosis is a common occurrence, mainly in Brazil, where many scientific investigations and theses have been done about this matter. In the treatment of cromomycosis is noteworthy the good results that Bopp (1957) got with the association of iodic and vitamin D_2.

Histoplasmosis has been studied very carefully lately in various countries of South America, mainly after the demonstration, by the histoplasmin test, that there are many reactors among the people. *Histoplasma capsulatum* has been isolated from the soil and from wild and domestic animals in South America, as well as other countries of the world.

Up to the present coccidioidomycosis has not been found in Brazil, and in the other countries of South America it does not represent an important epidemiological problem. Coccidioidomycosis has been found in Venezuela and Argentina, but in very few instances.

Rhinosporidiosis has been studied in Brazil mainly by Thiago de Mello and most of the cases published were of the nasal form.

Sporotrichosis is very frequent, mainly in Brazil, where about 0.5 per cent of all the dermatoses is of this etiology. The most variable clinical forms are frequent in patients attending the dermatological out patients service. The contribution of Brazilian researchers concerning the value of sporotrichin test in the diagnosis of sporotrichosis is important, and they have pointed out the great sensibility of the test (sporotrichin prepared with the yeast form of *Sporotrichum Schenckii*).

Actinomycosis is more frequent than maduromycosis, and in the majority of the cases it is produced by *Actinomyces brasiliensis*, which was identified for the first time by Lindenberg (1909), in Brazil.

The fungi *Monosporium apiospermum*, *Cephalosporium falciforme*, and *Madurella grisea*, are the most frequently recovered from cases of Maduromycosis.

In the end of his summary the Author discusses pulmonary mycosis by *Neogeotrichum pulmoneum* and refers to two cases of mycosis of the central nervous system probably produced by *Cladosporium trichoides*.

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LIBRI NOVI

MYCOLOGIE MÉDICALE. Communications et rapports présentées aux Journées de Mycologie Médicale (14—15 Décembre 1956) organisées par l'Institut Pasteur et la Société Française de Mycologie Médicale. (Medical Mycology). Contributions and reports presented at the meeting of Medical Mycology (December 14—15, 1956) organised by the Pasteur Institut and the French Society for Medical Mycology). Paper. 344 pages. Published by L'Expansion Scientifique Française, 15, rue Saint-Benôit, Paris-VIe. 1958.

This "Medical Mycology" is not a text on the subject but an extraordinary collection of papers presented at the meeting of the French Society of Medical Mycology, celebrating at the same time the birthday of this young Society. Prof. TRÉFOUËL, director of the Pasteur Institut, addressed the Society and doctor RIVALIER, director of the famous Laboratoire Sabouraud at the Hôpital Saint-Louis, as president of the Society, opened the meeting.

His opening address will become a classical program for medical mycology for all future. But about that later.

At this remarkable meeting six topics have been presented: 1) Aspergillosis of the respiratory tract; 2) Cerebral mycoses; 3) Mycoses due to *Candida*; 4) Dermatomycoses; 5) Tropical mycoses; 6) Therapy of mycoses. Seventy-three noted research workers participated in the preparation of these papers. Some of the collaborators are well known also in the English-speaking world of mycology: RIVALIER, successor of SABOURAUD, head of the Laboratoire Sabouraud at the Hôpital Saint-Louis; SEGRETAIN, chef of the Service de Mycologie et de Physiologie végétale, Pasteur Institut, with his able collaborators DROUHET and MARIAT; COUDERT-LYON and many others whose names are too many to be enumerated.

In every of the six main topics two to seven papers have been presented. Mycoses due to *Candida* are particularly thoroughly covered by eleven contributors, containing more than 100 pages.

The presentation of the themata is most detailed and excels in methodological knowledge of the investigators. This is the most valuable feature of this collection. This know-how, how to attack a mycological problem as to clinic, laboratory, histopathology, therapy is carried through all the presentation with the greatest consistency. Every paper has a summary in French, German English and Spanish in correct, idiomatic use of the language, perfectly reflecting the contents of the papers. Beside black and white illustrations (very good), there are six colored tables on aspergillosis, *Candida* infections, mycetoma, histoplasmosis and chromoblastomycosis. Every paper has its very complete bibliography, including not only the Latin language but also the German and English literature. Paper, print, choice of the illustrative material are excellent.

As was already stated, the greatest value of this collection of papers, beside the factual material excellently presented, lies in the iron-clad methodological principle carried through all the contributions. No mycological publication presented this methodological principle more precisely and eloquiently than RIVALIER whom we gladly quote: " . . . Maint cas pathologique devra donc être examiné avec l'esprit critique le plus aigu afin d'éviter les deux éceuils habituels, ou bien déclarer aussitôt coupable l'*Aspergillus* ou la levure qui pousse dans nos tubes, ou le mépriser d'emblée parce que rencontré communément en dehors de toute maladie".

RIVALIER summed up the same principles this reviewer is fighting for for decades. This is, in other words, that not even a repeated pure culture of a yeast-like organism or a hyphomycete is an evidence **in itself** for its pathogenicity and its etiologic significance. The final proof must come from other methods than that of the culture.

This volume is a great asset to the mycological literature at large. The methodological principles laid down should be followed by all mycologists. The young French Society for Medical Mycology and the Pasteur Institut have to be congratulated on the substance of this meeting and on the outstanding presentation of this collection of excellent investigative papers.

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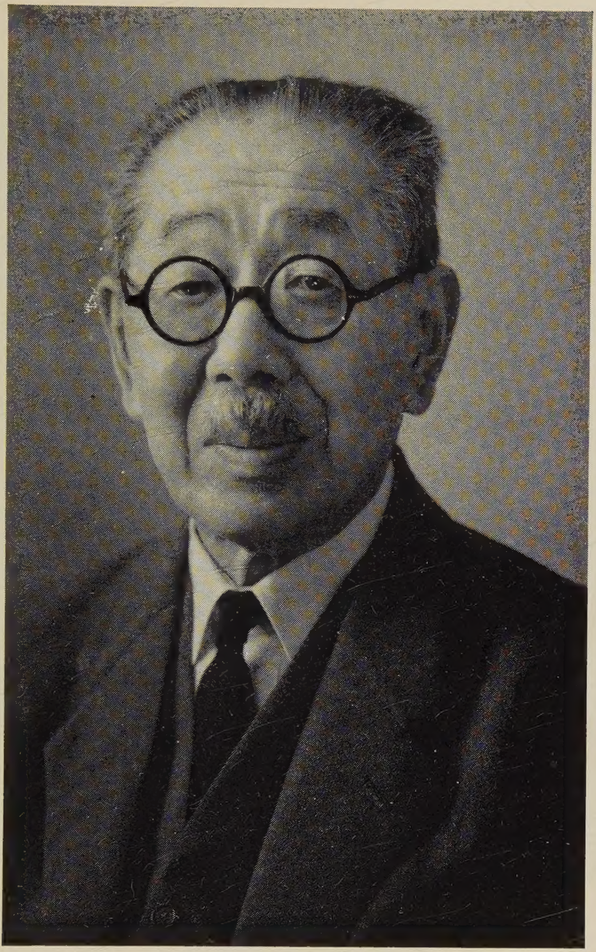

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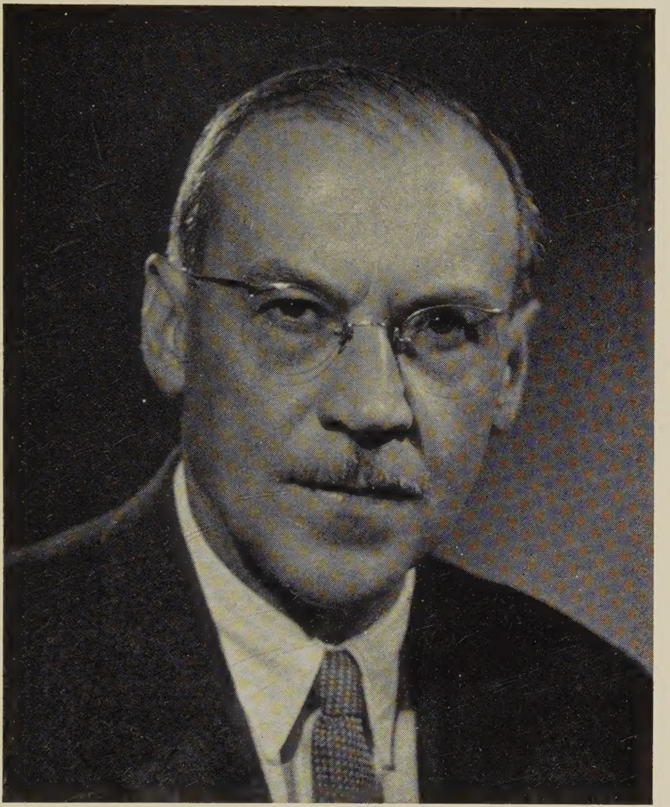

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